



This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

### Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

- + *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.
- + *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.
- + *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.
- + *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

### About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at <http://books.google.com/>

---

---

*GENERAL LIBRARY of the*  
*UNIVERSITY OF MICHIGAN*

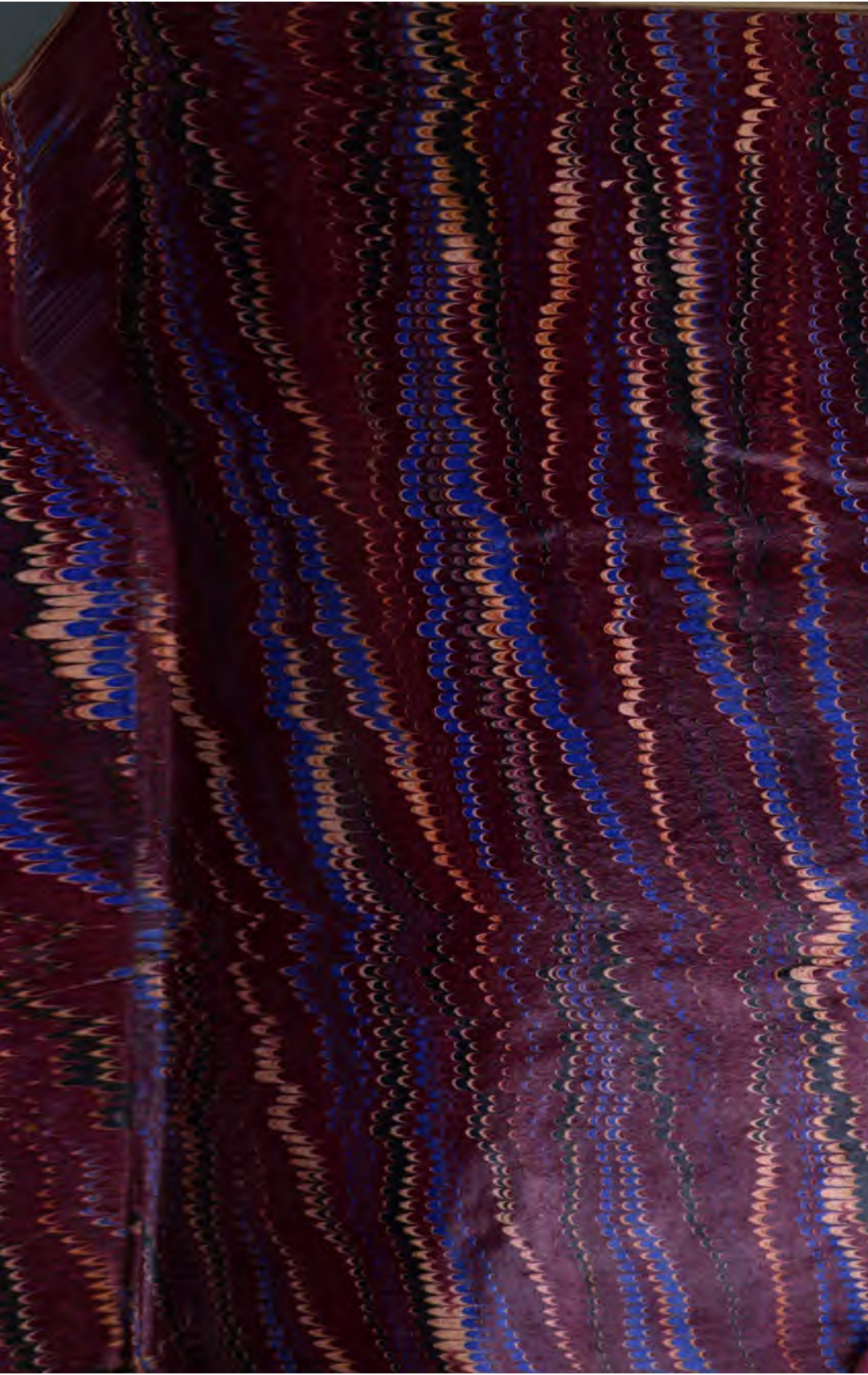
---

---

—PRESENTED BY—

*War Dept*

*2/4/05*





B 1,034,463



---

---

GENERAL LIBRARY of the  
UNIVERSITY OF MICHIGAN

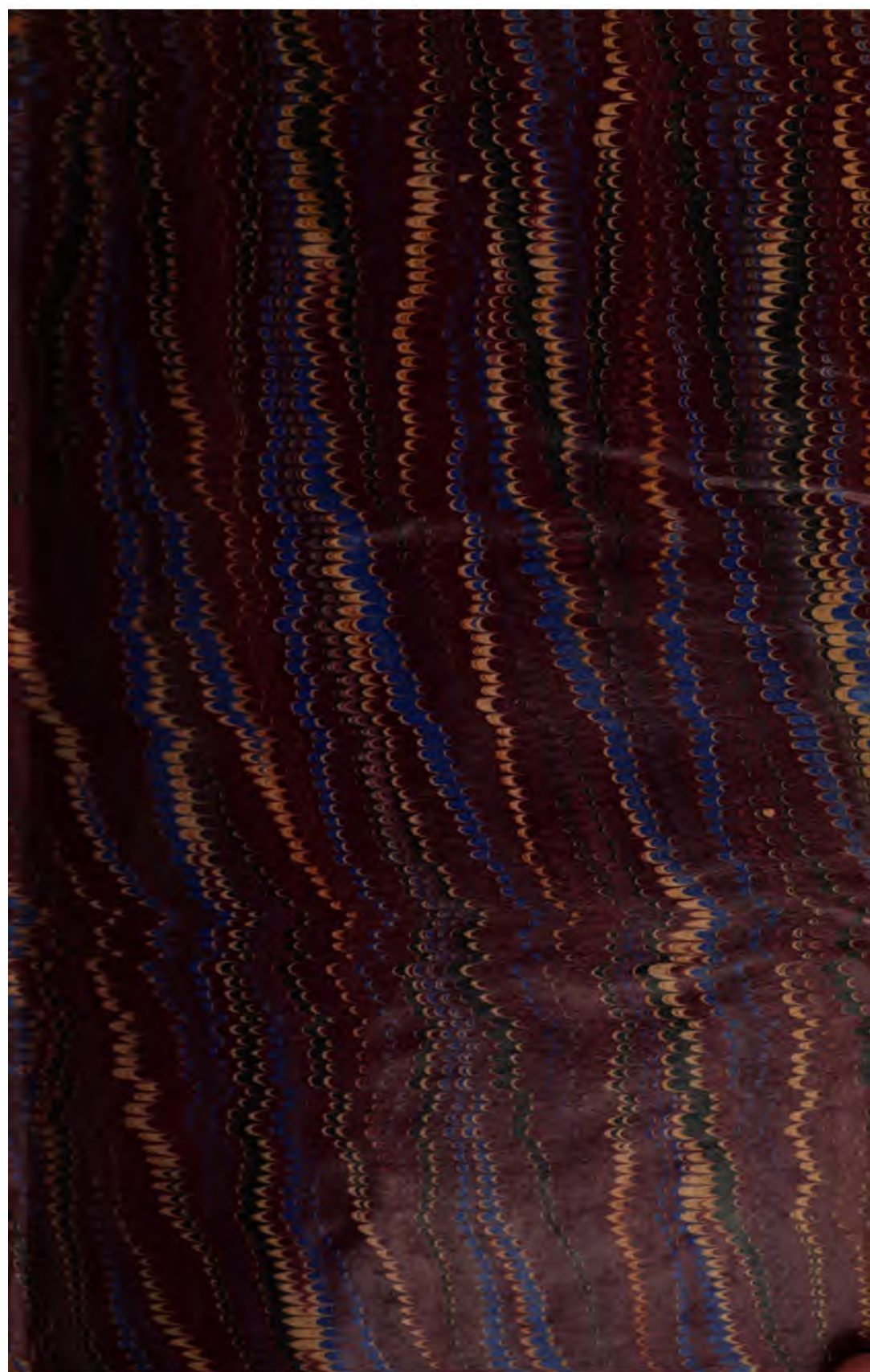
---

---

PRESENTED BY

War Dept

2/4/05







26A  
24  
A15











ANNUAL REPORTS  
OF THE  
WAR DEPARTMENT

FOR THE  
FISCAL YEAR ENDED JUNE 30, 1903.

---

VOLUME XI.  
REPORT OF THE CHIEF OF ENGINEERS.  
PART 3.

---

WASHINGTON.  
GOVERNMENT PRINTING OFFICE  
1903.



# ARRANGEMENT OF THE ANNUAL REPORTS OF THE WAR DEPARTMENT FOR THE YEAR ENDED JUNE 30, 1903.

---

**Volume I.—Secretary of War:**

Chief of Staff.  
Adjutant-General.  
Inspector-General.  
Judge-Advocate-General.

**Volume II.—Armament, Transportation and Supply:**

Quartermaster-General.  
Commissary-General.  
Surgeon-General.  
Paymaster-General.  
Chief of Engineers, Military Affairs.  
Chief of Ordnance.  
Chief Signal Officer.  
Chief of Artillery.  
Board of Ordnance and Fortification.

**Volume III.—Department and Division Commanders:**

Department of California.  
Department of the Colorado.  
Department of the Columbia.  
Department of Dakota.  
Department of the East.  
Department of the Lakes.  
Department of the Missouri.  
Department of Texas.  
Division of the Philippines—  
1. Department of Luzon.  
2. Department of the Visayas.  
3. Department of Mindanao.

**Volume IV.—Military Schools and Colleges; Record and Pension Office;**

**Military Parks, and Soldiers' Homes:**

Military Academy—  
1. Board of Visitors.  
2. Superintendent.  
Army War College.  
General Service and Staff College.  
School of Application for Cavalry and Field Artillery.  
Artillery School.  
School of Submarine Defense.  
Chief of Record and Pension Office.  
Commissioners of National Military Parks—  
1. Chickamauga and Chattanooga.  
2. Gettysburg.  
3. Shiloh.  
4. Vicksburg.  
Soldiers' Home, District of Columbia—  
1. Board of Commissioners.  
2. Inspection of.  
Inspection of National Home for Disabled Volunteer Soldiers.

**Volumes V-VIII.—Reports of the Philippine Commission, the Chief of Bureau of Insular Affairs, and Acts of the Philippine Commission.**

**Volumes IX-XIII.—Chief of Engineers, River and Harbor Improvements.**

132694





---

---

**APPENDIXES**

**TO THE**

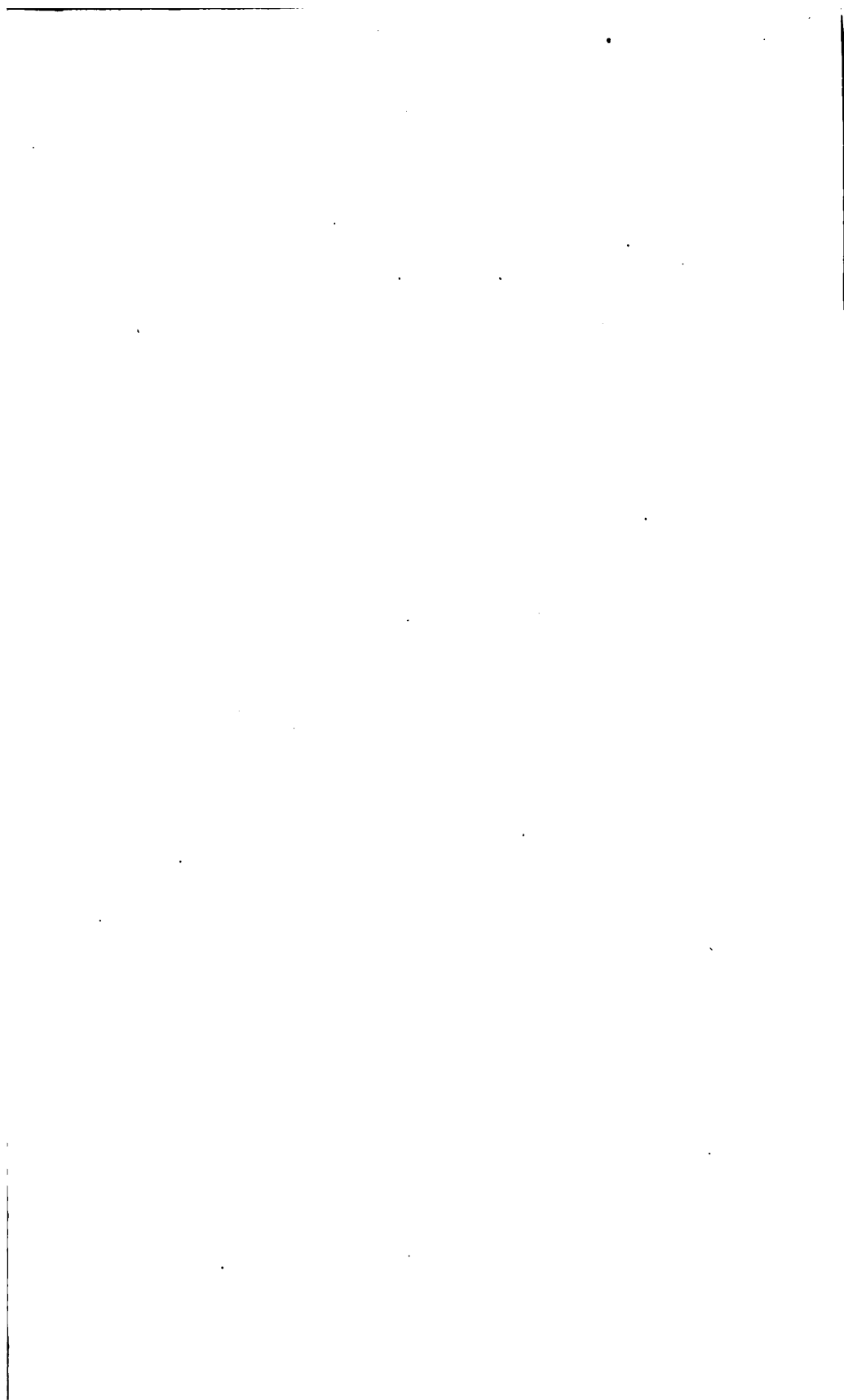
**REPORT OF THE CHIEF OF ENGINEERS,**

**UNITED STATES ARMY.**

**(CONTINUED.)**

---

---



## APPENDIX M M.

---

IMPROVEMENT OF CHICAGO AND CALUMET HARBORS AND OF CHICAGO RIVER, ILLINOIS, OF CALUMET RIVER, ILLINOIS AND INDIANA; SURVEY OF ILLINOIS AND DES PLAINES RIVERS, ILLINOIS, FOR WATERWAY FROM LOCKPORT, ILLINOIS, TO ST. LOUIS, MISSOURI.

---

REPORT OF COL. O. H. ERNST, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1903, WITH OTHER DOCUMENTS RELATING TO THE WORKS.

### IMPROVEMENTS.

- |   |  |
|---|--|
| 1. Chicago Harbor, Illinois.            | 5. Survey of Illinois and Des Plaines  |
| 2. Chicago River, Illinois.             | rivers, Illinois, for waterway from    |
| 3. Calumet Harbor, Illinois.            | Lockport, Illinois, to St. Louis, Mis- |
| 4. Calumet River, Illinois and Indiana. | souri.                                 |
- 

UNITED STATES ENGINEER OFFICE,  
*Chicago, Ill., July 14, 1903.*

GENERAL: I have the honor to forward herewith the annual reports upon the works in my charge for the fiscal year ending June 30, 1903.

Very respectfully, your obedient servant,

O. H. ERNST,  
*Colonel, Corps of Engineers.*

Brig. Gen. G. L. GILLESPIE,  
*Chief of Engineers, U. S. A.*

---

### M M I.

#### IMPROVEMENT OF CHICAGO HARBOR, ILLINOIS.

*Outer basin.*—This basin originally covered 455 acres of the area of Lake Michigan, of which 270 acres lie seaward of the dock line established by the Secretary of War September 22, 1890, and 185 acres west of this dock line. The dock line is about 1,300 feet east of the right of way of the Illinois Central Railroad and 2,000 feet distant from and parallel to the easterly breakwater of the basin.

Under authority granted by the Secretary of War July 24, 1895, a bulkhead has been constructed along the dock line, and the area

shoreward of the dock line is now being filled in by the city of Chicago for a public park. The remainder of the area is being dredged to a depth of 20 feet.

Under a contract with the Lydon & Drews Company, in force at the beginning of the fiscal year, dredging was continued and a total of 327,136 cubic yards were removed to December 6, 1902, at which time the contract was closed.

This dredging, with former work, resulted in a 21-foot channel in the river from Pine street to the lake, and the same depth over the bar at the harbor entrance and over an anchorage ground extending southwardly from the river a distance of 3,000 feet for a width of about 1,150 feet, comprising an area of about 79 acres, this depth being measured below the Chicago city datum.

Repairs to the decking of the north pier were made at a cost of \$181.

The location of the works is shown upon the accompanying sketch (I).

The piers and breakwaters, except the north pier, are generally in good condition. Being constructed of wooden cribs ballasted with stone, their superstructures must all, in the course of time, be rebuilt; but unless some unexpected accident should occur, that work may be deferred several years for all except the north pier. That pier has suffered from fire and collisions, as well as decay.

It is proposed to replace the superstructure of the north pier with concrete having about the same weight as the present superstructure. It is to be provided with a small gallery or protected passage way for the use of the light-keeper at times of severe storms or when the outer walk is covered with ice, as shown upon the accompanying sketch (II). At the outer end of the pier will be placed a solid pier head, 30 feet square. The work is estimated to cost \$85,000. Under the authority contained in your indorsement of June 22, 1903, that amount is included among the estimates submitted with this report.

There has been compiled in this office from the latest information obtainable and by correspondence with vessel owners and others, a list of vessels visiting Chicago during the calendar year 1901, showing their tonnage, number of visits, dimensions, and draft light and draft loaded. From this table the following summary has been made:

Total tonnage of vessels visiting the port .....	4, 244, 498	
Tonnage on draft of 9 feet or less .....	9, 227 or	0. 21 per cent
Tonnage on draft of 9 to 10 feet .....	22, 784 or	. 53 per cent
Tonnage on draft of 10 to 11 feet .....	331, 249 or	7. 8 per cent
Tonnage on draft of 11 to 12 feet .....	274, 481 or	6. 46 per cent
Tonnage on draft of 12 to 13 feet .....	488, 601 or	11. 4 per cent
Tonnage on draft of 13 to 14 feet .....	396, 767 or	9. 34 per cent
Tonnage on draft of 14 to 15 feet .....	655, 498 or	15. 44 per cent
Tonnage on draft of 15 to 16 feet .....	274, 230 or	6. 46 per cent
Tonnage on draft of 16 to 17 feet .....	616, 059 or	14. 51 per cent
Tonnage on draft of 17 to 18 feet .....	372, 857 or	8. 78 per cent
Tonnage on draft of 18 to 19 feet .....	528, 388 or	12. 44 per cent
Tonnage on draft of 19 to 20 feet .....	28, 310 or	. 54 per cent
Tonnage on draft of 20 to 21 feet .....	7, 802 or	. 18 per cent
Tonnage on draft of 21 to 22 feet .....	10, 472 or	. 24 per cent
Tonnage on small vessels, draft unknown .....	232, 773 or	5. 48 per cent

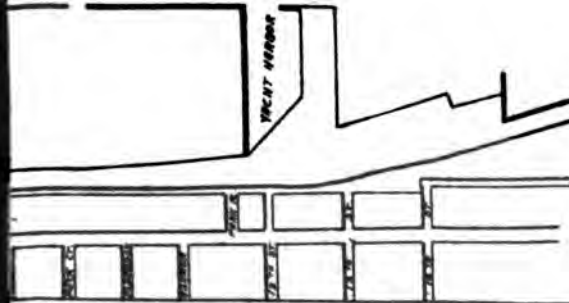
It is proposed to use the funds now available and those recommended for appropriation for the fiscal year ending June 30, 1904, in dredging the outer basin, in maintaining existing work, and in rebuilding the superstructure of the north pier in concrete.





N.

SOUTHERLY  
BROOKWAY



1. The first part of the document is a list of names and addresses of the members of the committee.

2. The second part of the document is a list of names and addresses of the members of the committee.

3. The third part of the document is a list of names and addresses of the members of the committee.

4. The fourth part of the document is a list of names and addresses of the members of the committee.

5. The fifth part of the document is a list of names and addresses of the members of the committee.

6. The sixth part of the document is a list of names and addresses of the members of the committee.

7. The seventh part of the document is a list of names and addresses of the members of the committee.

8. The eighth part of the document is a list of names and addresses of the members of the committee.

9. The ninth part of the document is a list of names and addresses of the members of the committee.

10. The tenth part of the document is a list of names and addresses of the members of the committee.

11. The eleventh part of the document is a list of names and addresses of the members of the committee.

12. The twelfth part of the document is a list of names and addresses of the members of the committee.

13. The thirteenth part of the document is a list of names and addresses of the members of the committee.

14. The fourteenth part of the document is a list of names and addresses of the members of the committee.

15. The fifteenth part of the document is a list of names and addresses of the members of the committee.

16. The sixteenth part of the document is a list of names and addresses of the members of the committee.

17. The seventeenth part of the document is a list of names and addresses of the members of the committee.

18. The eighteenth part of the document is a list of names and addresses of the members of the committee.

19. The nineteenth part of the document is a list of names and addresses of the members of the committee.

20. The twentieth part of the document is a list of names and addresses of the members of the committee.

A diagram of a rectangular structure, likely a foundation or wall, with a total length of 10'-0". The structure is divided into three sections by two vertical lines. The leftmost section is 4'-0" wide, the middle section is 2'-0" wide, and the rightmost section is 4'-0" wide. The total length is indicated by a dimension line at the top with arrows pointing to the ends, labeled "10'-0\".

M.L.L.

C.C.Q.

250 11, 11, 11

250 11, 11, 11

*Money statement.*

July 1, 1902, balance unexpended .....	\$39,600. 72
June 30, 1903, amount expended during fiscal year .....	37,157. 78
July 1, 1903, balance unexpended .....	2,442. 94
July 1, 1903, balance available .....	2,442. 94
(Amount (estimated) required for completion of existing project.....)	409,960. 00
Amount that can be profitably expended in fiscal year ending June 30, 1905, in addition to the balance unexpended July 1, 1903:	
For works of improvement.....	\$285,000. 00
For maintenance of improvement .....	10,000. 00
	295,000. 00.
Submitted in compliance with requirements of sundry civil act of June 4, 1897, and of section 7 of the river and harbor act of 1899.	

## LIST OF APPROPRIATIONS.

By act .....	\$100,000. 00
March 3, 1871 .....	100,000. 00
June 10, 1872 .....	90,000. 00
March 3, 1873 .....	90,000. 00
June 23, 1874 .....	75,000. 00
March 3, 1875 .....	78,000. 00
August 3, 1876 .....	5,000. 00
June 18, 1878 .....	75,000. 00
March 3, 1879 .....	75,000. 00
June 14, 1880 .....	145,000. 00
March 3, 1881 .....	150,000. 00
August 2, 1882 .....	200,000. 00
July 5, 1884 .....	100,000. 00
August 5, 1886 .....	75,000. 00
August 11, 1888 .....	200,000. 00
September 19, 1890 .....	100,000. 00
July 13, 1892 .....	72,000. 00
August 18, 1894 .....	80,000. 00
March 3, 1899 .....	100,000. 00
Total appropriated .....	1,910,000. 00
Received from all sources since 1870 (transfer of tugs, sales, etc.) .....	921. 16
Total .....	1,910,921. 16
Expenditures to June 30, 1903 .....	1,908,478. 22
Balance unexpended June 30, 1903 .....	2,442. 94

*List of contracts in force during fiscal year ending June 30, 1903.*

Name and address of contractor.	Nature of contract.	Date.	To expire.	Closed.
The Lydon & Drews Co., Chicago., Ill .....	Dredging .....	Mar. 25, 1901	July 15, 1902	Dec. 6, 1902

The contract was extended for a reasonable time from July 15, 1902.



# 1890 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

## COMMERCIAL STATISTICS.

Amount of revenue collected during fiscal year 1903, \$9,751,644.72.

*Arrivals and clearances of vessels, Chicago Harbor, for fiscal year 1902.*

	Arrivals.		Clearances.	
	Number.	Tons.	Number.	Tons.
Steam.....	5,505	4,381,095	5,458	4,255,157
Sail.....	767	254,382	807	270,327
Total.....	6,272	4,635,477	6,260	4,525,484

*Receipts and shipments by lake at Chicago during calendar year 1902.*

Receipts.	Quantity.	Shipments.	Quantity.
	<i>Tons.</i>		<i>Tons.</i>
Hard coal.....	200,352	Wheat.....	308,568
Soft coal.....	62,491	Corn.....	429,072
Iron ore.....	53,085	Oats.....	65,698
Lumber.....	1,193,490	Flaxseed.....	11,037
Shingles.....	24,287	Rye.....	37,863
Lath.....	612	Barley.....	3,744
Posts.....	40,144	Flour.....	214,343
Ties.....	90,479	Grass seed.....	480
Poles.....	41,599	Mill stuffs.....	33,085
Wood.....	19,131	Malt.....	2,873
Salt.....	161,906	Oil cake.....	6,301
Plaster.....	3,473	Glucose.....	9,694
Cement.....	147,602	Pork.....	1,138
Whiting.....	13,429	Beef.....	39
Asphalt.....	9,678	Cured meats.....	533
Sulphur.....	2,862	Spelter.....	3,220
Copper.....	10,385	Lead.....	2,622
Nails.....	1,926	Manufactures of iron.....	6,490
Hardware.....	21,431	Hides.....	250
Wool and hair.....	541	Leather.....	443
Boots and shoes.....	15,476	Tallow.....	2,540
Hides.....	827	Wool and hair.....	3,612
Coffee.....	21,785	Broom corn.....	304
Sugar.....	256,160	Soap.....	8,482
Potatoes.....	5,372	Sugar.....	6,607
Grain.....	54,647	Lard.....	7,694
Canned goods.....	31,814	Sirup.....	2,935
Soap.....	2,609	Canned goods.....	6,392
Groceries.....	506,860	Groceries.....	17,375
Unclassified.....	618,996	Unclassified.....	377,925
Total.....	3,613,438	Total.....	1,571,354

*Comparison of receipts and shipments for years 1893 to 1902, inclusive.*

Year.	Tons.	Year.	Tons.
1893.....	7,958,963	1898.....	7,391,454
1894.....	7,209,236	1899.....	6,189,365
1895.....	7,206,942	1900.....	5,873,070
1896.....	6,347,163	1901.....	6,184,242
1897.....	7,149,759	1902.....	5,184,792

REPORT OF MR. G. A. M. LILJENCRANTZ, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,  
Chicago, Ill., July 2, 1903.

COLONEL: I have the honor to submit the following report on operations in Chicago Harbor, Illinois, during the fiscal year ending June 30, 1903.

There was one contract in force during the first part of the year for work of improvement of this harbor, viz, with the Lydon & Drews Company of Chicago, Ill., dated

March 25, 1901, for dredging over the bar at the harbor entrance, in the river to Rush Street Bridge, and in the "Outer Basin," from its junction with the river southwardly as far as available funds would permit. The contract price was at the rate of 7.45 cents per cubic yard, scow measurement.

## WORK DONE DURING THE YEAR.

At the close of the year ending June 30, 1902, the dredging to a depth of 21 feet below low water of 1847 (= Chicago city datum) was completed over the bar at the entrance to the harbor, in the river to Rush Street Bridge, and in the "Outer Basin," the latter for a width of 1,150 feet, counting westwardly from a line running parallel to and 50 feet from the easterly breakwater, and a distance southwardly of 1,920 feet, whereby an anchorage ground was created in the northerly portion of the basin. The work during the year ending June 30, 1903, consisted in extending this anchorage area 1,080 feet farther, or to a point 3,000 feet from the south pier. This anchorage area is now 79.2 acres in extent. Most of the material was dumped in the space reserved for the "Lake Front Park," or, as it is to be hereafter called "The Grant Park," which is being gradually filled up. The total amount of material dredged under the above contract was:

	Cubic yards.
To June 30, 1902 .....	825, 951
During year ending June 30, 1903 .....	327, 136
Total under the contract .....	1, 153, 087

Work under the contract was completed on December 6, 1902, the final payment made on the 17th of that month, and the contract closed.

The result of the work is a free and unobstructed entrance to harbor and river and an anchorage ground, 79.2 acres in area, in the "Outer Basin." This area would undoubtedly prove of much greater value if the dredging was continued so as to connect with the southerly entrance to the basin, and if the channel in the lake leading to this entrance was given the same depth, whereby deep-draft vessels would be able to use either entrance. The project of 1878, modified as to depth in 1899, provided for the deepening of the whole basin area to the dock line established by the Secretary of War, which dock line now forms the easterly boundary to the "Grant Park."

In a letter from the United States light-house inspector of the ninth light-house district, dated December 15, 1902, attention was called to the dangerous condition of the north pier, on account of the defective decking, which made it unsafe for the light keeper to pass over it to the beacon in the dark or in snowstorms. Repairs were accordingly made, sufficient for present purposes, by and under an agreement with the Lydon & Drews Company of this city, at a cost of \$181.

## CONDITION OF THE WORKS ON JUNE 30, 1903.

The easterly and southerly breakwaters are in fair condition, except as follows: The decking is more or less decayed in scattered places, especially along the southerly part of the former, and along the latter, planking being here and there either broken in places or entirely gone. Near the northerly end of the easterly breakwater is the break caused by the steamer *Kalamazoo*, of the Williams Line, which ran into it on July 3, 1901, which break has never been repaired. The stone ballast has settled considerably in both of these breakwaters, but, protected as they are from severe northerly winds by the exterior breakwater, refilling may be safely deferred until the superstructure is rebuilt, which will probably be required in four or five years. The exterior breakwater is in very good condition, save in a few isolated places, where the decking and some top side timbers are somewhat decayed, and in two places where damage has been done by unknown vessels having run against the structure. The south pier is generally in fair condition, but the north pier, east of the so-called "light-house slip," is in a bad state of demolition. Damages to this work, by a number of collisions with vessels and by several fires, augmented by the action of the elements and a general decay, has reduced the superstructure of this pier to a condition requiring attention at an early date. This pier serves as a protection for vessels entering the harbor, and it is provided with a beacon light and fog bell at its outer end, wherefor its maintenance in good condition is of importance.

Considering the danger from fire to the said beacon light, as well as to the pier itself, and considering also the steadily increasing cost of timber of all kinds, it would seem advisable to substitute a new concrete superstructure for the old timber work. The cost of this would probably not exceed \$90,000.

## 1892 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

### WORK PROPOSED FOR THE ENSUING YEAR.

There being at present no funds available for any work of improvement of this harbor, no work is now proposed for the ensuing year.

I am, Colonel, very respectfully, your obedient servant,

G. A. M. LILJENCRANTZ,  
*Assistant Engineer.*

Col. O. H. ERNST, *Corps of Engineers.*

---

### M M 2.

#### IMPROVEMENT OF CHICAGO RIVER, ILLINOIS.

This river constitutes the inner harbor of Chicago, Ill. Its navigable parts lie wholly within the city limits of Chicago.

In the Annual Report of the Chief of Engineers for 1893, page 2974, may be found a full report upon this stream and its needed improvement, and in his Annual Report for 1897, page 2793, a history of the improvement and some detailed information as to the obstructions to navigation existing along its channels. Reference is made in his report of 1902, page 2097, to the work undertaken by the Sanitary District of Chicago in connection with the improvement of this river.

At the close of the fiscal year ending June 30, 1902, the project under the act of June 3, 1896, as modified by the act of June 4, 1897, for improvement by dredging to allow passage by vessels drawing 16 feet of water, and to cut away certain obstructive bends and projecting docks, had been completed.

During the fiscal year just closed no work was done by the United States, but the Sanitary District of Chicago continued its work of improvement, having dredged 476,344 cubic yards of material and built 5,078 linear feet of new dock, and having completed and opened for traffic one bridge across the main river at State street and four across the South Branch. For this information I am indebted to Mr. Isham Randolph, chief engineer of the sanitary district.

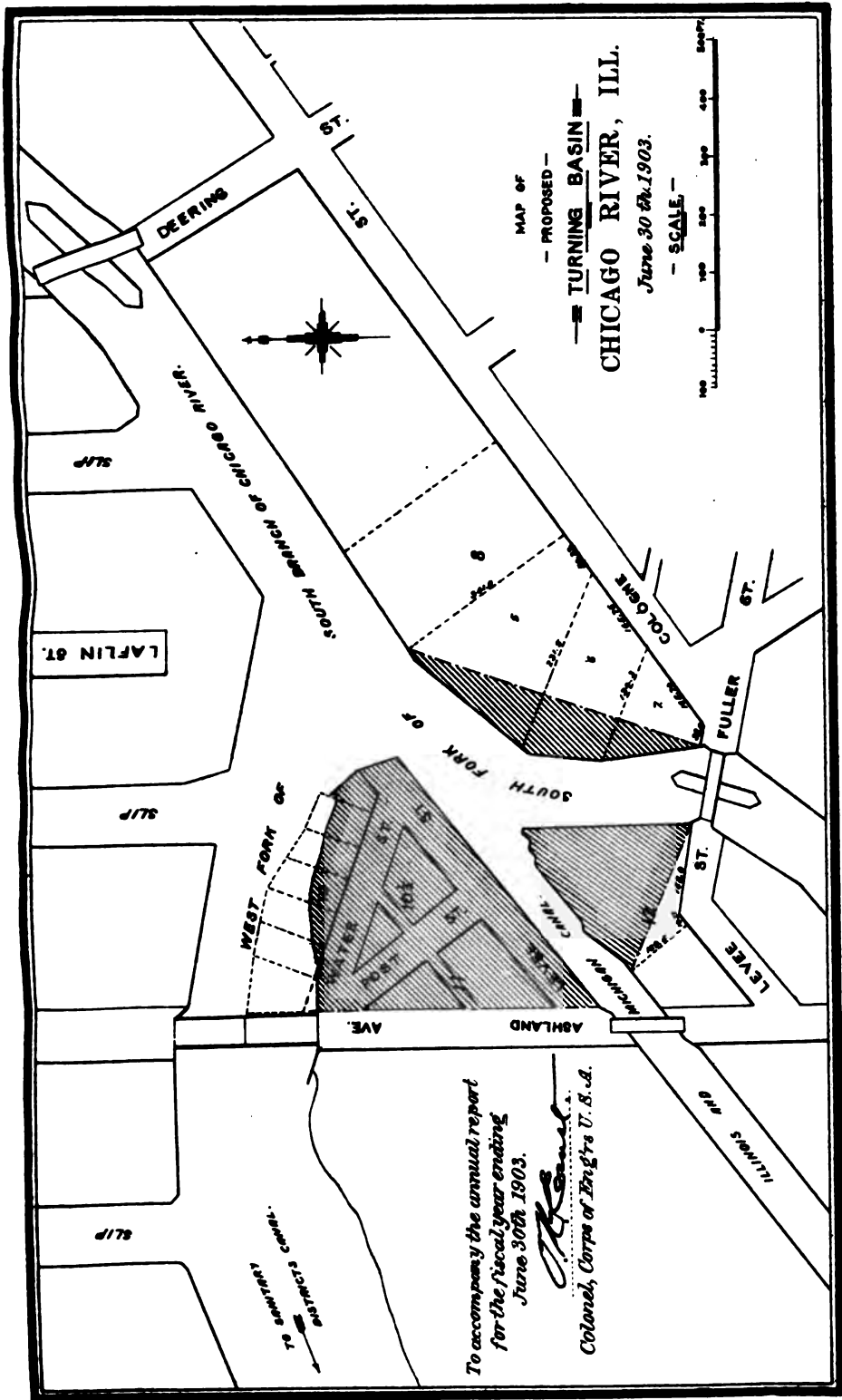
By the act of June 13, 1902, Congress provided for two turning basins.

Sites for the basins were selected, one in the South Branch at its junction with the South Fork and West Fork, and the other in the North Branch near the head of Goose Island—see accompanying sketches (III, IV, and V)—and the project having received the approval of the Department, surveys were made and steps were taken to secure the necessary land, either by purchase under voluntary agreement or by condemnation. Three of the leading men in the real estate business in Chicago, Messrs. William A. Bond, Eugene H. Fishburn, and George Birkhoff, jr., were employed as a board of experts to appraise the value of the lands required, and Mr. A. C. Mace was employed as expert to fix the damages to buildings. The prices fixed by these gentlemen have been considered the maximum limit of what the Government could properly pay in all negotiations with the owners. Of the six tracts of land comprising the North Branch basin, two have been acquired under voluntary agreement and four will probably have to be condemned. Of the sixteen tracts comprising the South Branch basin, one has been ceded by the State of Illinois, agreements have









To accompany the annual report  
for the fiscal year ending  
June 30th 1903.

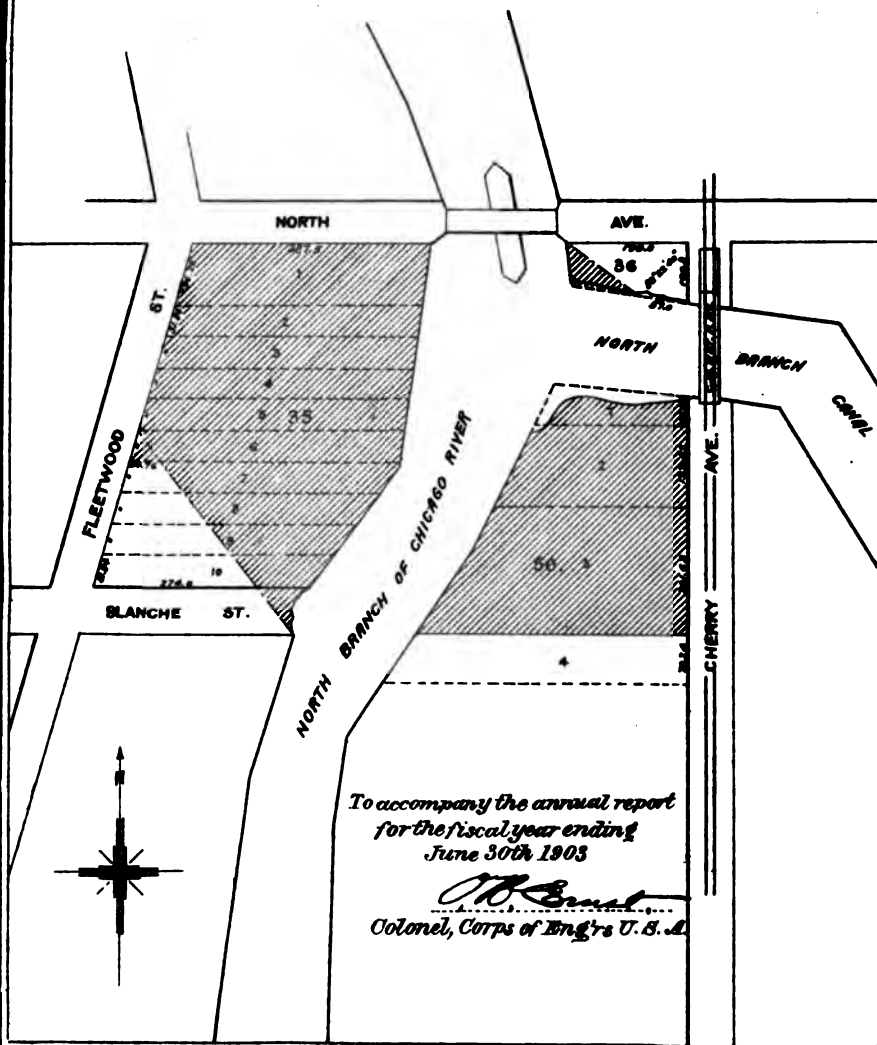
*J. R. Gould*  
Colonel, Corps of Eng'rs U. S. A.



MAP OF  
 — PROPOSED —  
 — TURNING BASIN —  
 CHICAGO RIVER, ILL.

June 30<sup>th</sup> 1903.

— SCALE —



*To accompany the annual report  
 for the fiscal year ending  
 June 30<sup>th</sup> 1903*

*W. B. Smith*  
 Colonel, Corps of Eng'rs U. S. A.



been made for the purchase of five, the title papers for which are in the hands of the Attorney-General for approval; agreement for the purchase of one tract has been forwarded for the approval of the Secretary of War; for three tracts agreements have been made verbally, but not as yet in writing, and six tracts will probably have to be condemned. A copy of the act of the Illinois legislature ceding the tract above mentioned is hereto appended. This office is indebted to Mr. L. O. Goddard, secretary of the Chicago River Improvement Association, for valuable assistance in making known the merits of this case to the large number of persons who were required to vote upon it in the legislature.

The volume of business transacted in the river during the calendar year 1902 was about 1,000,000 tons less than in the preceding year and was less than in any year since 1893, as shown in the comparative statement attached to my report on Chicago Harbor. The commodities received and shipped by lake were in 1902 5,184,792 tons against 6,184,242 tons in 1901 and against 7,958,963 tons in 1893. The volume of lake trade in 1902 was only 65 per cent of what it was in 1893, and this notwithstanding the great revival of business activity since 1893. More than half the decrease in 1902 was in the single article of coal, and this was due to abnormal circumstances. There may be an increase next year, but the figures as a whole show conclusively a decline, which has been almost continuous since 1893. The decline is due to the obstructions to navigation in the river, particularly the tunnels—see Annual Report, Chief of Engineers, 1902, page 2098—and will no doubt continue unless they are removed.

There was no contract in force in Chicago River during the fiscal year 1903.

*Money statement.*

July 1, 1902, balance unexpended .....	\$507, 954. 61
June 30, 1903, amount expended during fiscal year .....	162, 613. 08
July 1, 1903, balance unexpended .....	345, 341. 53
July 1, 1903, balance available .....	345, 341. 53

APPROPRIATIONS.

Act of June 3, 1896 .....	\$50, 000. 00
Sundry civil act, June 4, 1897 .....	113, 000. 00
Sundry civil act, July 1, 1898 .....	400, 000. 00
Sundry civil act, June 6, 1900 .....	62, 000. 00
Act of June 13, 1902 .....	306, 457. 00
Received from sale of property .....	18. 12
Total .....	931, 475. 12
Expenditures to June 30, 1903 (exclusive of \$25,000 allotted from appropriation for Chicago Harbor of August 18, 1894) .....	586, 133. 59
Balance unexpended July 1, 1903 .....	345, 341. 53

AN ACT to cede certain lands to the United States.

Whereas the United States Government is desirous of constructing a turning basin for lake vessels in the Chicago River, and an appropriation has been made by Congress of the United States therefor; and

Whereas it is important to the successful construction and proper location of said

turning basin that the United States should have certain of the canal lands belonging to the State of Illinois: Therefore,

SECTION 1. *Be it enacted by the people of the State of Illinois represented in the general assembly,* That there be, and is hereby, ceded to the United States for use in constructing a turning basin, the following land, to wit: All that part of lot 1 shown on the "plat of the canal commissioners' subdivision of that part of the southwest quarter of section twenty-nine, township 39 north, of range fourteen east of the third principal meridian, lying south of the main canal west of the Chicago River, and known as blocks twelve and thirteen of the canal trustees' subdivision of blocks ten, ten and a half, eleven, twelve, and thirteen, in the southwest quarter of said section twenty-nine; also block 'A,' not previously surveyed or platted in said southwest quarter section, and east of the Chicago River," in the city of Chicago, Cook County, Illinois, as follows: Lying north of a line beginning at a point on the southwesterly line of said lot 1, distant 129.5 feet in a westerly direction from the northwesterly side of Levee street, said point being also at the intersection of the said southwesterly line of said lot 1 with the present (November, 1902) south dock of the Illinois and Michigan Canal; thence in an east by south direction to the intersection of the easterly side of said lot 1 with the northerly side of Levee street, containing 41,466 square feet.

SEC. 2. Jurisdiction of the State of Illinois over said lands is hereby ceded to the United States, subject, however, to the right of the State and any and all officers under its authority to serve and execute on said lands any civil or criminal process issued under the authority of the State of Illinois or any officer thereof in the same manner as if jurisdiction had not been ceded to the United States.

Approved May 13, 1903.

REPORT OF MR. G. A. M. LILJENCRANTZ, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,  
Chicago, Ill., July 2, 1903.

COLONEL: I have the honor to submit the following report on operations in Chicago River, Illinois, during the fiscal year ending June 30, 1903:

There was no contract in force during the year for any work of improvement of this river and no such work was done. By act of Congress approved June 13, 1902, the sum of \$306,457 was appropriated for "continuing improvement," with the following provision: "That the sum of \$193,543, unexpended balance of money heretofore appropriated for the improvement of Chicago River, making the total sum \$500,000, may be used in the improvement of said river by constructing turning basins of proper size in said river, said turning basins to be located by, and said money expended under the direction of, the Secretary of War."

Preliminary steps were taken to carry out the provisions of the said act. The project for the work was submitted to the Department and approved by the Secretary of War on August 18, 1902. Sites for the basins were selected. Surveys of these were made in the beginning of September, and maps, showing the boundaries and the various parcels of land required, were forwarded to the Department on November 29, 1902. Authority to employ a board of appraisers to fix the values of parcels of land to be secured was obtained on October 20, 1902. Authority was also obtained on November 11, 1902, for engaging an appraiser of the values of buildings, which would be either in whole or in part affected by the improvement.

The appraisers so appointed proceeded with their investigations and submitted their reports in due time, on the basis of which there was prepared an estimate of cost of the proposed improvement, which estimate was submitted to the Department and approved by the Chief of Engineers on December 11, 1902. The estimate in brief—including the purchase of land, removal of the same, damages to adjoining property and to buildings affected, construction of docks where necessary, and incidental expenses—was as follows:

For construction of the North Branch basin.....	\$317,000
For construction of the South Branch basin.....	183,000
Total.....	500,000

#### WORK DONE DURING THE YEAR.

Project and estimate having been duly approved, steps were taken to secure the necessary land by purchase under voluntary agreement or by condemnation.

The land required was divided into tracts, according to owners and to locations in



the blocks and subdivisions. Thus there are in the North Branch basin six tracts and in the South Branch basin sixteen, or in all twenty-two tracts. Some of these have the same owners, but, being located in different blocks, were treated as separate tracts.

Securing of title papers proved rather slow work, owing in part to a general disposition of many of the owners to hold out for larger amounts than those suggested by the appraisers' valuations. Some owners have delayed from time to time with giving definite replies to requests for their signatures to "agreements," while others have absolutely refused to accept the appraisers' figures. Others, again, while willing to accept such figures, had no abstract of title and could not afford to secure these, and condemnation proceedings will therefore have to be instituted in a number of cases, and steps have been taken to this end. Another circumstance that has retarded progress in the clearing up of titles to the tracts is the fact that quite a number of persons, directly or indirectly interested in the transfers, were found to be scattered all over the country, in the East and in California, etc., and negotiations with these people, through letters, proved very slow work.

The state of progress with the various tracts was on June 30, 1903, as follows:

(a) LAND SECURED.

(a) By purchase under voluntary agreement: Tracts Nos. 1 and 2 of the North Branch basin.

(b) By act of legislature (donation): Tract No. 13 of the South Branch basin.

(b) LAND FOR WHICH THE TITLE PAPERS ARE IN THE HANDS OF THE ATTORNEY-GENERAL FOR APPROVAL.

[Agreements having been approved by the Secretary of War.]

Tracts Nos. 1, 2 (undivided half of), 3, 5, and 16 of the South Branch basin.

(c) LAND FOR WHICH "AGREEMENTS" HAVE BEEN RECEIVED AND FORWARDED FOR THE APPROVAL OF THE SECRETARY OF WAR, BUT OTHER PAPERS NOT YET RECEIVED.

Tract No. 14 of the South Branch basin.

(d) LAND FOR WHICH NEITHER "AGREEMENTS" NOR OTHER PAPERS HAVE BEEN RECEIVED AS YET.

Tracts 2 (undivided half of), 4, 6, and 14 of the South Branch basin.

(e) LAND THAT WILL HAVE TO BE CONDEMNED.

Tracts 7, 8, 9, 10, 11, and 12, South Branch basin, and  
Tracts 3, 4, 5, and 6 of the North Branch basin.

In addition to the land to be condemned, there is a small dwelling on tract 6, South Branch basin, owned by a squatter, who refuses to accept the appraised valuation, and this dwelling must be condemned. The land is owned by the Chicago Terminal Transfer Railroad Company and is to be purchased under voluntary agreement.

In all cases where a whole lot or a number of lots owned by one party have been taken for the improvement, the abstracts of title to such property have been donated to the United States, and one copy has been made of each for the file of the office, but in cases where only a portion of a party's land is to be taken the abstracts have been copied in duplicate and the original returned to the owners.

It was expected that the condemnation proceedings would be commenced during the July term of the court, but from information lately received it appears probable that this will be delayed until the October term.

\* \* \* \* \*

Chicago River has never had a complete and consistent system of dock lines established. The city council has at different times established dock lines in isolated places, but without regard to any definite system as a whole, and to ascertain to what extent this had been done Mr. W. M. Kramer was temporarily employed to search the city ordinances and official maps for information on this subject and report on the results. He submitted his report, with copies of official maps, on the 31st of July, 1902.

# 1896 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

## WORK PROPOSED FOR THE ENSUING YEAR.

It is proposed to secure during the ensuing year, by purchase or otherwise, all the tracts of land required for the improvement and not yet secured, and to commence the actual work of construction of the turning basins.

I am, Colonel, very respectfully, your obedient servant,

G. A. M. LILJENCRANTZ,  
*Assistant Engineer.*

Col. O. H. ERNST, *Corps of Engineers.*

---

### M M 3.

#### IMPROVEMENT OF CALUMET HARBOR, ILLINOIS.

The object of the work originally was to provide a deep entrance to the Calumet River and the port of South Chicago. Under the latest project it is also to provide a harbor of refuge and anchorage ground in front of the river mouth as well as an easy approach to the entrance.

The first object is accomplished by first protecting the proposed channel by parallel piers 300 feet apart projecting into the lake from the shore, and then dredging between them to the proper depth. Work was begun in 1870, and by the 30th of June, 1876, 2,020 linear feet of the south pier and 3,640 feet of the north pier had been completed and a channel 16 feet deep between the piers had been secured, which completed the old project.

By the act of June 3, 1896, the project was enlarged so as to provide for an extension of the piers and an increase in the channel depth to 20 feet.

By the act of March 3, 1899, it was still further enlarged so as to provide for—

1. A breakwater 4,400 feet long connected with the shore and running due east into the lake, terminating in water 32 feet deep.

2. A second breakwater about 2,000 feet long running in a southerly direction from the outer end of the first, but detached therefrom, the interval between the two breakwaters to be not less than 2,500 feet, the exact location of the second breakwater and the necessity of building it to be left for determination after completion of the first.

3. The anchorage area sheltered by these breakwaters to be dredged to 20 feet depth.

4. Extending the south pier at the mouth of the Calumet 800 feet.

5. Dredging in the Calumet River to a width of 200 feet and depth of 20 feet for a distance of 2 miles from the mouth.

The act of June 13, 1902, authorized a modification of the first and second items by substituting for the detached breakwater an extension in a southeasterly direction of the first breakwater for a distance not to exceed 2,500 feet. See accompanying Sketch VI.

At the beginning of the fiscal year the fourth and fifth items had been completed. Work was progressing on the first item, the east and west breakwater, under contract dated July 7, 1899, with the Hausler & Lutz Towing and Dock Company, and that was nearly completed. The work remaining to be done was to sink the last two cribs, build the superstructure, including decking, over 1,000 linear feet, and place the unfinished part of the ice guard. The breakwater

MAP OF  
CALUMET HARBOR, ILL.

June 30th. 1903.

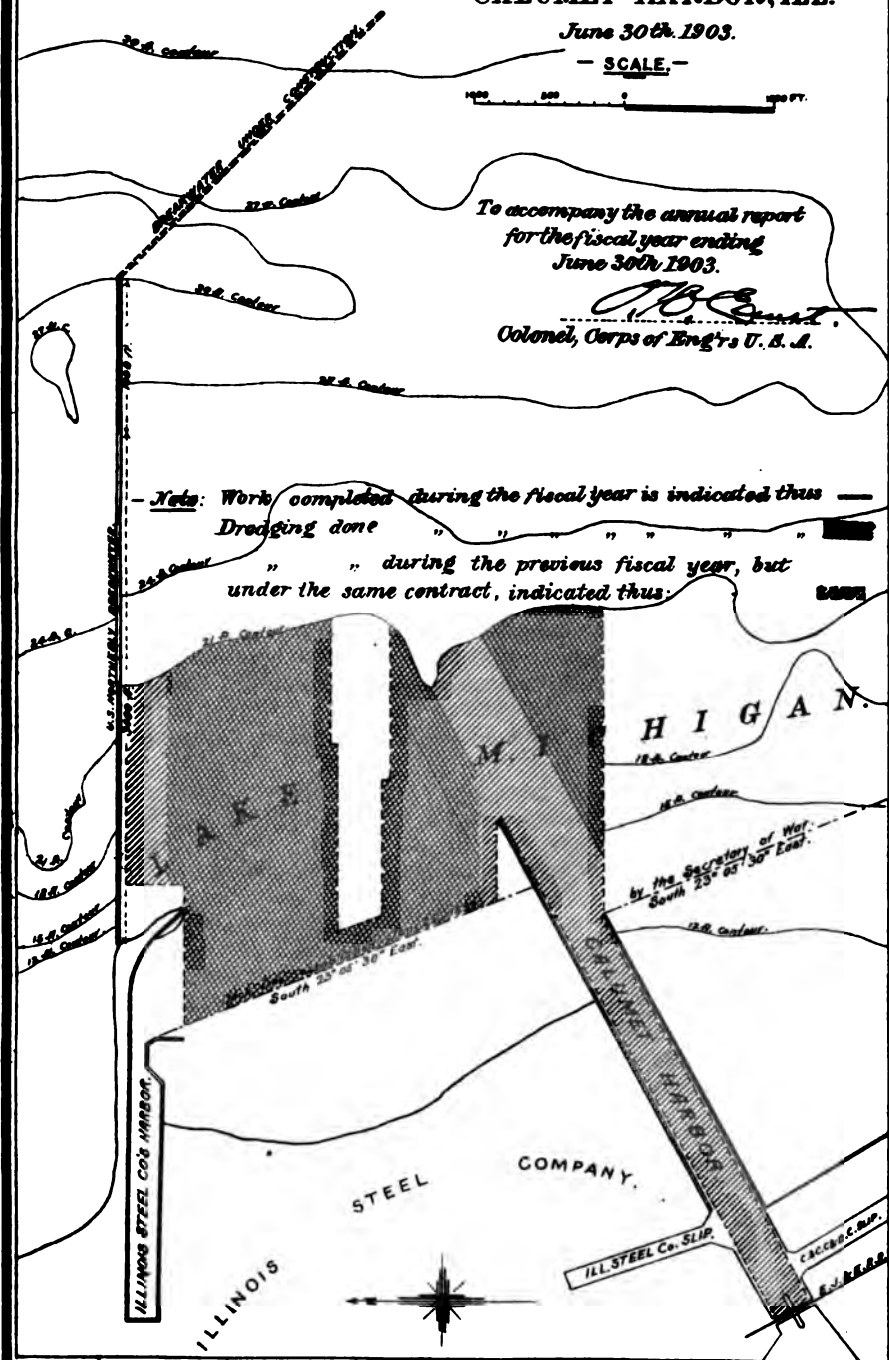
— SCALE —

1000 500 0 1000 FT.

To accompany the annual report  
for the fiscal year ending  
June 30th. 1903.

*M. E. Smith*  
Colonel, Corps of Eng'rs U. S. A.

— Note: Work completed during the fiscal year is indicated thus —  
Dredging done " " " " " " " " " " " "  
" " during the previous fiscal year, but  
under the same contract, indicated thus: " " " " " "





was completed on the 31st of October, 1902, and the contract closed, the total payments to the contractor amounting to \$343,642.40.

Under the third item, dredging the area sheltered by breakwater, a contract was entered into with the Lydon & Drews Company, of Chicago, March 19, 1902. At the beginning of the year 327,978 cubic yards of material had been removed, and during the year 905,233 cubic yards were removed, resulting in the deepening to 21 feet below Chicago city datum of 91 per cent of the area proposed to be dredged, and giving an unobstructed approach to the harbor from deep water in the lake 1,400 feet wide at the 21-foot contour and 300 feet wide at the entrance to the Calumet River.

For the extension of the breakwater in a southeasterly direction a contract was entered into November 12, 1902, with the firm of Gillen & Gillen, of Racine, Wis. Work under this contract was begun April 23, 1903. At the close of the year the stone foundation had been completed and leveled off for a distance of 150 feet and partly completed nearly 700 feet farther; 15 courses of the first crib had been placed and 3 courses of the second.

Under a contract entered into May 15, 1902, with Hausler & Lutz Towing and Dock Company for rebuilding the dock at the inner or westerly end of the north pier, work was commenced on July 29, 1902, and completed February 6, 1903, 453 linear feet of dock having been rebuilt, at a cost of \$11,063.41, exclusive of inspection and other charges.

December 9, 1902, the steamer *Matoa* ran into the new breakwater at a point 1,900 feet from its westerly end, making an opening about 36 feet wide and 18 feet deep below water level. This damage has been reported to the United States district attorney at St. Paul, Minn., with all the obtainable data relating thereto, with a view to the prosecution of a suit for damages against the owners of the vessel, the Pittsburg Steamship Company, of Duluth, Minn. An agreement has been entered into with the firm of Gillen & Gillen for the repair of the breakwater, at a cost of \$7,160.

A self-registering water gauge was placed during the winter at the outer end of the north pier. It did not show any abnormal changes of lake level until the last day of the fiscal year. There then occurred for several days a series of violent oscillations, such as have long been known to occur at times, but of which the definite records are meager.

\* \* \* The most remarkable changes occurred between 3.12 and 3.52 p. m., June 30, when the lake surface fell 18 inches; between 7.47 and 8.08 p. m. of the same date, when it rose 21.6 inches; between 10.20 and 10.50 p. m. of the same date, when it fell 16.8 inches; and between 12.12 and 12.32 a. m., July 1, when it rose 18.6 inches. The greatest range during any one day was from 1.6 feet above Chicago city datum, 8.08 p. m., June 30, to 0.6 foot below that plane 10.50 p. m. of the same date, a change of 26.4 inches.

A wharf has been built by the contractors for the breakwater extension, south of the breakwater and 1,000 feet from its westerly end, for their use in constructing the breakwater.

The piers at the mouth of the river are generally in fair condition, except about 300 or 400 linear feet of the south pier, the superstructure of which should be rebuilt.

It is proposed to apply the funds now available to the extension of the east and west breakwater in a southeasterly direction, to the com-

# 1898 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

pletion of the dredging of the area sheltered by breakwaters, and to the necessary repair and maintenance of the works.

## Money statement.

July 1, 1902, balance unexpended .....	\$486, 986. 02
Amount appropriated by sundry civil act approved March 3, 1903.....	204, 480. 00
	<hr/> 691, 466. 02
June 30, 1903, amount expended during fiscal year .....	227, 445. 95
	<hr/> 464, 020. 07
July 1, 1903, balance unexpended .....	464, 020. 07
July 1, 1903, outstanding liabilities .....	7, 160. 00
	<hr/> 174, 734. 70
July 1, 1903, balance available .....	174, 734. 70
July 1, 1903, amount covered by uncompleted contracts.....	282. 125. 37

## APPROPRIATIONS.

By act of—	
July 11, 1870.....	\$50,000. 00
March 3, 1871.....	50,000. 00
June 10, 1872.....	40,000. 00
March 3, 1873.....	40,000. 00
June 23, 1874.....	25,000. 00
March 3, 1875.....	25,000. 00
August 3, 1876.....	20,000. 00
June 18, 1878.....	15,000. 00
March 3, 1879.....	12,000. 00
June 14, 1880.....	20,000. 00
March 3, 1881.....	30,000. 00
August 2, 1882.....	35,000. 00
July 5, 1884.....	20,000. 00
August 5, 1886.....	10,000. 00
August 11, 1888.....	20,400. 00
September 19, 1890.....	20,000. 00
July 13, 1892.....	15,000. 00
August 18, 1894.....	15,000. 00
June 3, 1896.....	75,000. 00
March 3, 1899.....	150,000. 00
June 6, 1900.....	185,350. 00
March 3, 1901.....	255,000. 00
Sundry civil act of June 28, 1902.....	215,000. 00
Sundry civil act of March 3, 1903.....	204,480. 00
	<hr/> 1,547,230. 00
Total.....	1,547,230. 00
Amount received from sale of property .....	1. 00
	<hr/> 1,547,231. 00
Total.....	1,547,231. 00
Expended to June 30, 1903 .....	1,083,210. 93
	<hr/> 464,020. 07
Balance unexpended June 30, 1903 .....	464,020. 07

## List of contracts in force during fiscal year ending June 30, 1903.

Name and address of contractor.	Nature of contract.	Date.	To expire.	Closed.
Hausler & Lutz Towing and Dock Co., South Chicago, Ill.	Constructing breakwater.	July 7, 1899	Dec. 31, 1901	Oct. 31, 1902
Do.....	Dock construction .....	May 15, 1902	Sept. 15, 1902	Feb. 6, 1903
The Lydon & Drews Co., Chicago, Ill.	Dredging.....	Mar. 19, 1902	Sept. 1, 1903	
Gillen & Gillen, Racine, Wis..	Breakwater construction.	Nov. 12, 1902	Dec. 31, 1903	

The first two contracts were extended for a reasonable time from dates of expiration.

## COMMERCIAL STATISTICS.

Amount of revenue collected at nearest port of entry (Chicago) during fiscal year 1903, \$9,751,644.72.

*Arrivals and clearances of vessels at Calumet Harbor.*

	Arrivals.		Clearances.	
	Number.	Tons.	Number.	Tons.
Steam.....	847	1,691,512	919	1,819,899
Sail .....	332	615,963	332	643,718
Total.....	1,179	2,307,475	1,251	2,463,617

*Receipts and shipments by lake at South Chicago, Ill., during calendar year 1902.*

Receipts.	Quantity.	Shipments.	Quantity.
	<i>Tons.</i>		<i>Tons.</i>
Hard coal.....	36,669	Wheat.....	170,755
Iron ore.....	3,334,841	Corn.....	281,001
Lumber.....	83,298	Oats.....	52,032
Shingles.....	1,363	Rye.....	9,352
Posts.....	2,675	Barley.....	3,480
Railroad ties.....	8,335	Flour.....	31,935
Poles.....	32,588	Mill stuffs.....	1,460
Wood.....	1,196	Oil cake.....	1,465
Salt.....	178,535	Glucose.....	3,491
Plaster.....	62,850	Oil.....	35,106
Grain.....	53,133	Steel rails.....	21,368
Unclassified.....	9,900	Unclassified.....	37,600
Total.....	3,805,383	Total.....	649,045

*Comparison of receipts and shipments by lake at South Chicago, Ill., for calendar years 1893 to 1902, inclusive.*

Year.	Tons.	Year.	Tons.
1893.....	903,379	1898.....	4,117,526
1894.....	1,436,897	1899.....	3,229,874
1895.....	2,857,750	1900.....	3,783,674
1896.....	2,973,724	1901.....	3,995,277
1897.....	3,493,218	1902.....	4,454,428

REPORT OF MR. G. A. M. LILJENCRANTZ, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,  
Chicago, Ill., July 3, 1903.

COLONEL: I have the honor to submit the following report on operations in Calumet Harbor, Illinois, during the fiscal year ending June 30, 1903:

At the beginning of the year there were three contracts in force for work of improvement of this harbor, viz, with—

1. The Hausler & Lutz Towing and Dock Company, of South Chicago, Ill., dated July 7, 1899, for the construction of a breakwater 4,400 feet long, running due east from the Illinois Steel Company's north harbor pier.

2. The Lydon & Drews Company, of Chicago, Ill., dated March 19, 1902, for deepening the area sheltered by the new breakwater and the channel between the harbor piers; and

3. The first of the above-named firms, dated May 15, 1902, for rebuilding the dock at the inner or westerly end of the original north pier.

A fourth contract was entered into on the 12th of November, 1902, with Messrs. Gillen & Gillen, of Racine, Wis., for the extension of the breakwater in a southeast direction a distance of 2,500 feet. Under a special agreement with this firm, authorized on May 2, 1903, the damage done to the breakwater in December, 1902, by the steamer *Matoa* is to be repaired by them.

# 1900 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

## WORK DONE DURING THE YEAR.

Work under the first contract was continued until the 31st of October, 1902, when it was completed and the contract closed. At the beginning of the year all the work built on pile foundation (1,700 linear feet) was completed; the stone foundation was practically all in place to the end of the proposed work; all the 30-foot wide cribs were constructed and 42 of these were sunk on stone foundation; the superstructure was completed for a distance of 3,400 linear feet in all, including the decking. The ice guard was put on for a distance of 4,187 linear feet, counting both sides of the pier.

The year's work consisted accordingly in sinking of the last two cribs (Nos. 43 and 44) on the completed stone foundation; building superstructure, including decking, over 1,000 linear feet, and placing the unfinished part of the ice guard. Three clumps of piles were to have been placed at the outer end of the breakwater, but as this was to be farther extended it was deemed best to omit the clumps for the time, with a view to placing them at the end of the new extension, when completed, instead. After the final payment, on November 8, 1902, the contract was closed. In the completed breakwater the following materials were used and paid for, to wit:

Hemlock timber.....	feet B. M.	5,544, 786
Pine timber.....	do.	1,609, 362
Pine decking.....	do.	565, 000
Oak plank.....	do.	108, 969
Pine piles.....		884
White oak piles.....		17
Wrought-iron driftbolts.....	pounds.	613, 665
Wrought-iron screw bolts.....	do.	12, 713
Wrought-iron spikes.....	do.	42, 442
Stone.....	cords.	30, 211. 02
Dredging.....	cubic yards.	5, 412

The actual (measured) length of the finished breakwater was found to be 4,413 feet. The total cost of the work was \$343,642.40.

Work under the second contract was continued and 905,233 cubic yards of material were removed during the year. The total area proposed to be dredged under the contract contained 144.17 acres, of which 131.25 acres have been deepened to date, leaving, at the close of the year, 12.92 acres, or 8.96 per cent of the whole, yet to be dredged.

There is now a clear and unobstructed approach from deep water in the lake to each of the two harbors; the width of that leading to Calumet River being from 1,400 feet at the original 21-foot contour to 300 feet at the outer end of the south pier, and that to the steel company's harbor being 1,000 feet, counting southwardly from the end of the protruding arm of that harbor's north pier.

Work under the third contract was commenced on July 29, 1902, and continued until the 6th of February, 1903, when the work was completed. The final payment was made on the 7th of that month and the contract closed.

The total cost of this work, a length of 453 linear feet, was \$11,063.41, or at the rate of \$24.42 per linear foot, which price, however, includes the removal of the old revetment. This contract was to have expired on September 15, 1902, but on application of the contractors an extension of time was granted, on September 8, "for a reasonable time," with provision that the cost of inspection, after the time originally fixed for expiration, should be paid by the contractors.

Work under the fourth contract was begun on the 23d of April, 1903, when the first scow load of stone was placed in the line of the proposed work for a foundation. The construction of the first crib (an angle crib) was begun on June 12, that of the second crib on June 24. At the close of the year the first crib was 15 courses in height, the second 3 courses. The stone foundation is completed and leveled off for a distance of 150 feet and ready to receive the first crib. It is partly completed nearly 700 feet farther. Two thousand and two and seventy-one one hundredths cords of stone have been placed in the foundation to date.

The work of repairing the damaged place on the breakwater was begun during the latter part of June.

\* \* \* \* \*

When the dock in front of the United States reservation was to be rebuilt it was found necessary to move the old boathouse and office building (erected in 1872 or 1873) back from the river channel, to make room for the driving of the anchor piles. It was then found that the lower portion of the building was badly decayed. Authority for repairing the same was obtained and the work was done.



On the 9th of December, 1902, at about 4.30 a. m., the steamer *Matoa*, owned by the Pittsburg Steam Ship Company, of Duluth, Minn., ran into and through the breakwater at a point 1,900 feet from its westerly end, leaving an opening about 36 feet wide and 18 feet deep below water level. The lights at the end of the breakwater were burning at the time. The air was clear, according to official reports. Had there been a fog the steamer would hardly have dared running with a speed sufficient to cause such a break. Suit for damages has been brought against the company.

A self-registering water gauge—the E. E. Haskell design—has been placed at the outer end of the north pier, and is in successful operation. The value of such a gauge for securing accurate records of great and sudden fluctuations in the lake level is demonstrated on the sketch respectfully submitted herewith,<sup>a</sup> showing extraordinary fluctuations on three successive days, viz, on June 30 and July 1 and 2 of the present year.

A wharf has been constructed, by the contractors for the breakwater extension, south of the breakwater and 1,000 feet from its westerly end, under authority of the Secretary of War, dated May 6, 1903. On this wharf is received the timber and other materials for the new work. The cribs are constructed on it, and it has also a building for boarding and lodging the contractors' workmen.

When the contract for constructing the breakwater was closed the duty of the contractor to keep lights at the end of the work ceased, and as such duty does not evolve upon the contractor for extension until his first crib has been sunk, provision had to be made by this office for maintaining lights in the interim. Two lanterns were therefore secured, together with suitable oil, and a man was engaged to attend to the lights.

It is but fair to the contractors to state that much better progress would have been made with their contracts had not strikes and prevailing storms this spring caused serious delays.

#### CONDITION OF THE WORKS ON JUNE 30, 1903.

The piers are in generally fair or good condition, save the damage to the breakwater, and between 300 and 400 linear feet of the south pier, the superstructure of which latter is in need of being rebuilt.

#### WORK PROPOSED FOR THE ENSUING YEAR.

It is proposed to continue during the ensuing year with the construction of the breakwater extension, to continue and complete the deepening of the area sheltered by the breakwater, and to finish the repairs to the damaged part of the breakwater.

I am, Colonel, very respectfully, your obedient servant,

G. A. M. LILJENCRANTZ,  
*Assistant Engineer.*

Col. O. H. ERNST, *Corps of Engineers.*

---

#### M M 4.

#### IMPROVEMENT OF CALUMET RIVER, ILLINOIS AND INDIANA.

There was no work of excavation during the year. An attempt was made to apply the \$75,000 appropriated by the river and harbor act of June 13, 1902, to extending the 20-foot channel continuously upstream, which included rock excavation. Bids were invited by public advertisement and were opened October 29, 1902. The lowest bids received were 22½ cents per cubic yard for dredging, and \$5.50 per cubic yard for rock excavation. Being considered excessive, they were rejected.

It was then decided to omit all rock excavation and accept the depth of 14 feet, which is fixed by the rock near One hundred and twelfth

---

<sup>a</sup> Not printed.

# 1902 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

street, as the limiting depth for the channel higher up the river, and to extend the 20-foot depth from One hundred and sixth street, where it now terminates, to a short distance above Cumming's slip, between One hundred and ninth and One hundred and tenth streets, thus giving a continuous 20-foot channel from the mouth of the river to that point. It was also proposed to extend the 14-foot channel from the point where it now terminates, at One hundred and eighteenth street, as high up the river as the funds will permit. This modified project having received the approval of the Department, proposals were advertised for and were opened February 10, 1903. Griffiths, McDermott & Watt Dredging Company, of Chicago, were the lowest bidders, at 14½ cents per cubic yard, measured in place, and a contract was entered into with that company which received the approval of the Department March 20, 1903.

The contractors propose to do this work with a hydraulic dredge, which will discharge the dredged material in low places over the banks of the river. The dredge has been undergoing extensive repairs, but, owing to strikes, the repairs have not been completed, and no work has been done.

Careful soundings were again taken in June over the area to be dredged.

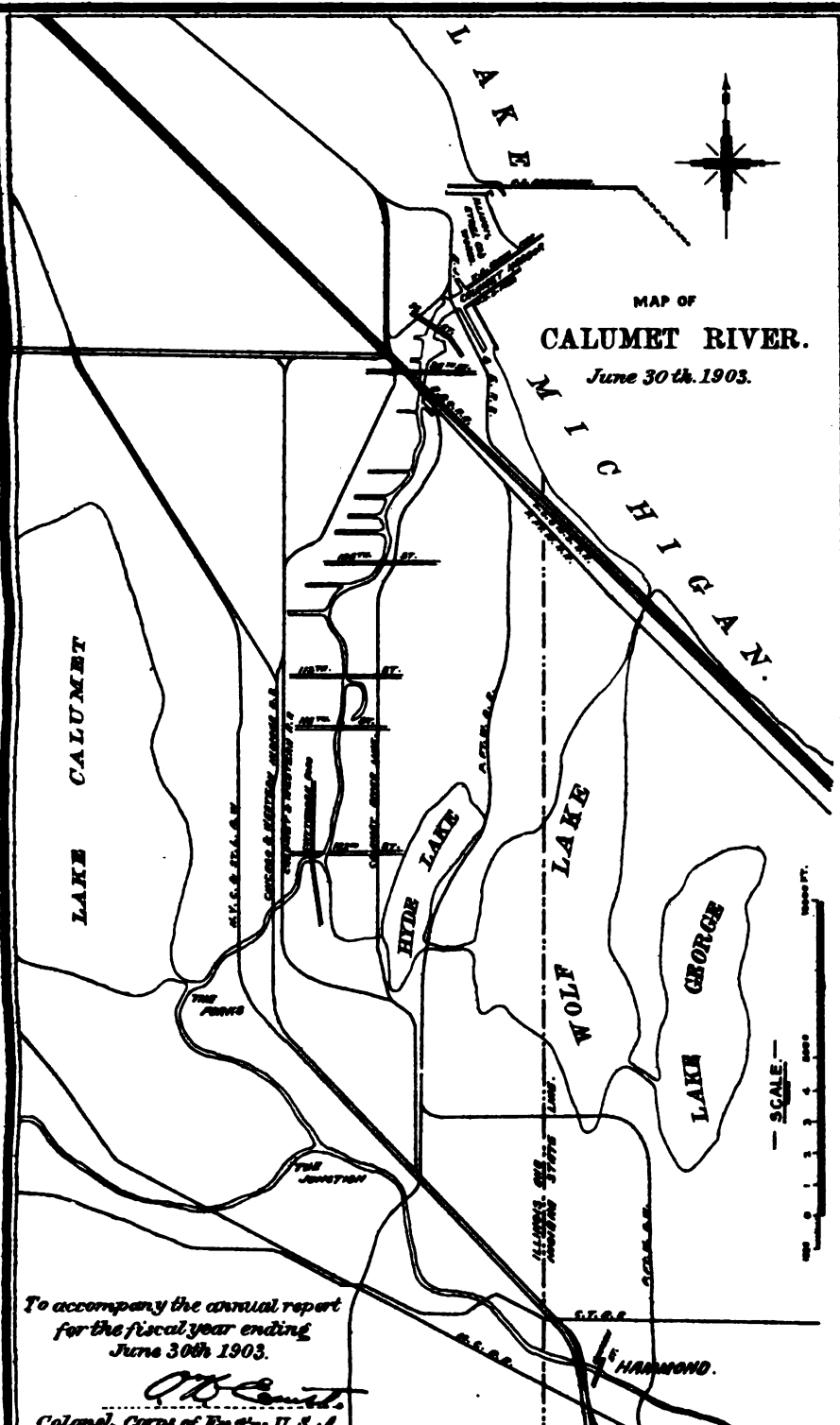
A sketch of the river is hereto appended (VII).

The lake trade of Calumet River and Harbor for the calendar year 1902 was nearly half a million tons greater than in the previous year, and was five times as great as in 1893, being 4,454,428 tons in 1902 against 3,995,277 tons in 1901, and against 903,379 tons in 1893. The growth has been almost continuous, as is shown in the tabular statement attached to my report on Calumet Harbor herewith. It is very far from having reached its limit. A number of large additional enterprises have planned to locate upon the river with the hope and belief that the obstructions to navigation will be removed. It is much to be desired that this be done without unnecessary delay. The amount which I recommend below as the "amount that can be profitably expended in the fiscal year ending June 30, 1905," is the amount required to complete the rock excavation. It is suggested that the place is of sufficient national importance to justify placing it under the continuous contract system.

It is proposed to apply the funds now available, and those asked for for the year ending June 30, 1905, to the enlargement of the channel progressively upstream to the dimensions prescribed.

## Money statement.

July 1, 1902, balance unexpended .....	\$85,017. 14
June 30, 1903, amount expended during fiscal year .....	2,655. 92
July 1, 1903, balance unexpended .....	82,361. 22
July 1, 1903, amount covered by uncompleted contracts .....	67,000. 00
(Amount (estimated) required for completion of existing project' .....	423,322. 50
Amount that can be profitably expended in fiscal year ending June 30, 1905, in addition to the balance unexpended July 1, 1903:	
For works of improvement .....	\$300,000. 00
For maintenance of improvement .....	10,000. 00
	310,000. 00
Submitted in compliance with requirements of sundry civil act of June 4, 1897, and of section 7 of the river and harbor act of 1899.	



MAP OF  
CALUMET RIVER.

June 30th. 1903.

To accompany the annual report  
for the fiscal year ending  
June 30th 1903.

*W. B. Smith*  
Colonel, Corps of Engrs. U. S. A.

1. The first part of the document discusses the importance of maintaining accurate records of all transactions and the role of the accounting department in ensuring the integrity of the financial statements. It also highlights the need for regular audits and the importance of transparency in financial reporting.

2. The second part of the document focuses on the implementation of internal controls to prevent fraud and ensure the accuracy of financial data. It outlines the key components of a robust internal control system, including segregation of duties, authorization procedures, and regular monitoring and evaluation.

3. The third part of the document addresses the challenges faced by organizations in managing their financial resources effectively. It discusses the importance of budgeting and forecasting, and the role of the accounting department in providing accurate and timely financial information to management for decision-making.

4. The fourth part of the document explores the impact of technology on the accounting profession. It discusses the benefits of automation and the use of cloud-based accounting systems, as well as the need for continuous learning and professional development for accountants.

5. The fifth part of the document concludes by emphasizing the importance of ethical behavior in the accounting profession. It discusses the role of accountants as trusted advisors and the need to adhere to the highest standards of integrity and honesty in all financial transactions.

## APPROPRIATIONS.

By act of—

July 5, 1884.....	\$50,000.00
August 5, 1886.....	30,000.00
August 11, 1886.....	50,000.00
September 19, 1890.....	50,000.00
July 13, 1892.....	75,000.00
August 18, 1894.....	45,000.00
June 3, 1896.....	50,000.00
March 3, 1899.....	60,000.00
June 13, 1902.....	75,000.00
Total.....	485,000.00
Expended to June 30, 1903.....	402,638.78
Balance unexpended June 30, 1903.....	82,361.22

*List of contracts in force during fiscal year ending June 30, 1903, Calumet River, Illinois and Indiana.*

Name and address of contractor.	Nature of contract.	Date.	To expire—
Griffiths, McDermott & Watt Dredging Co., Chicago, Ill.	Dredging....	Feb. 20, 1903.	Nine months after opening of navigation in 1903.

## REPORT OF MR. G. A. M. LILJENCRAFT, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,  
Chicago, Ill., July 6, 1903.

COLONEL: I have the honor to submit the following report on operations in Calumet River, Illinois and Indiana, during the fiscal year ending June 30, 1903.

There was no contract in force at the beginning of the year for any work of improvement of this river. Congress having appropriated \$75,000 by act approved June 13, 1902, it was proposed to dredge the deteriorated channel between the harbor and One hundred and sixth street; to deepen the channel from One hundred and sixth street southwardly, with a 50-foot wide channel through the westerly side of the "rock section" (between One hundred and eleventh and One hundred and thirteenth streets) to 20 feet, in accordance with the provisions of the said act. Proposals were advertised for on September 25 and opened on October 29 following, 1902, but the lowest bids received, 22½ cents per cubic yard for dredging and \$5.50 for rock excavation, each measured "in place," were rejected, being considered too high. New proposals were again advertised for on January 8, 1903, and opened on February 10 following, for work on a different plan, viz, for dredging to a depth of 20 feet from One hundred and sixth street to One hundred and tenth street and to 14 feet in depth from One hundred and eighteenth street southwardly as far as available funds would permit. The lowest bid received, 14½ cents per cubic yard, measured "in place," was received from Messrs. Griffiths, McDermott & Watt, of Chicago, Ill., and was accepted. The bid was approved by the Chief of Engineers on the 17th of February and a contract entered into with the said firm on the 20th of the same month. The contract was approved by the Chief of Engineers on March 20, 1903.

## WORK DONE DURING THE YEAR.

It was expected that operations would have begun at the end of March or the beginning of April, and preparations were made accordingly. Soundings were taken over the area in which the work was to be commenced and the channel lines were reestablished and marked on the ground. It is proposed to do this work with a hydraulic dredge, every part of which has been in process of being thoroughly overhauled for that purpose, but a number of strikes, both by the contractors' workmen and by men in the shops where work had been ordered, have caused so much delay that at the close of the year no work had yet been begun.

# 1904 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

CONDITION OF THE CHANNEL ON JUNE 30, 1903.

The channel between the harbor and One hundred and sixth street has an average depth of from 18 to 20 feet, the deeper part being near the harbor. From One hundred and sixth street to One hundred and eighteenth street, the channel was dredged in 1899 and 1900 to a depth of 16 feet, except at the rock section, between One hundred and eleventh and One hundred and thirteenth streets. Between the latter street and the limit of this dredging, at One hundred and eighteenth street, considerable shoaling has taken place, as must be expected. There is at times quite a strong current, carrying sand and silt in suspension, through the narrower channel above One hundred and eighteenth street, and when this current reaches the wider and deeper part of the channel north of the said street, the current is suddenly reduced and the suspended material deposited on the bottom. Thus there was found only 7 feet depth in the middle of the channel that had been deepened to 16 feet about four years ago.

The rock section heretofore referred to forms a very serious detriment to the usefulness of the river above and its removal is therefore of great importance, as a number of very large enterprises have planned to locate in this vicinity, but have deferred action because of this obstruction. The amount of rock and impenetrable hardpan that would have to be removed to provide a channel 21 feet deep and 200 feet in width has been estimated at 61,550 cubic yards. This estimate is based on close soundings taken through the ice in February, 1902. The cost of removing the rock, if done under one contract, is estimated as follows:

61,550 cubic yards at \$4.50 .....	\$276, 975. 00
Add 15 per cent for contingencies .....	41, 546. 25
Total .....	318, 521. 25

Though ultimately the whole width of the channel must be deepened, a great temporary relief to navigation would be obtained if work could be done over half of the width (the deeper, west half) at an early date; but I beg leave to suggest that, unless an appropriation is made large enough to cover the cost of the whole work, it would be most economical to do this work under the continuous-contract system, so that all of it could be let under one contract. Lower bids would in such a case unquestionably be received.

\* \* \* \* \*

The new project to extend the 20-foot channel depth to One hundred and twenty-second street has greatly increased the general interest in this river, as evidenced by new enterprises started, and others contemplated or negotiated for, during the year.

## WORK PROPOSED FOR THE ENSUING YEAR.

It is proposed to commence work under the existing contract some time during the present month and to complete the same before the close of the year ending June 30, 1904.

I am, colonel, very respectfully, your obedient servant,

G. A. M. LILJENCRANTZ,  
Assistant Engineer.

Col. O. H. ERNST, Corps of Engineers.

## M M 5.

### SURVEY OF ILLINOIS AND DES PLAINES RIVERS, ILLINOIS.

The river and harbor act of June 13, 1902, contained the following proviso, viz:

The sum of two hundred thousand dollars, or so much thereof as may be necessary, is hereby appropriated for making such surveys, examinations, and investigations as may be required to determine the feasibility of, and to prepare and report plans and estimates of cost of, a navigable waterway fourteen feet in depth from Lockport, Illinois, by way of the Des Plaines and Illinois rivers, to the mouth of said Illinois River, and from the mouth of the Illinois River, by way of the Mississippi River, to Saint Louis, Missouri: *Provided*, That twenty-five thousand dollars of said sum, or so much thereof as may be necessary, may be expended by the Mississippi

River Commission in making surveys, examinations, and investigations herein required from the mouth of the Illinois River to Saint Louis: *Provided further*, That the Secretary of War shall appoint a board of three engineers to make the surveys, examinations, and investigations hereinbefore required from Lockport, Illinois, through the Des Plaines River and Illinois River, to the mouth of said Illinois River, and that all such surveys, examinations, and investigations shall be made to determine the feasibility of, and to prepare and report plans and estimates of cost of, a navigable waterway fourteen feet in depth from Lockport, Illinois, to Saint Louis, Missouri. The said Mississippi River Commission shall make said report covering such proposed improvement from the mouth of the Illinois River to Saint Louis, and the said Board of Engineers shall make such report from Lockport, Illinois, to the mouth of the Illinois River: *And provided further*, That the said Board of Engineers shall also make such surveys, examinations, and investigations as may be required to determine the feasibility of, and to prepare a report and plans and estimates of cost of, a navigable waterway seven feet in depth and of a navigable waterway eight feet in depth from the head of navigation of the Illinois River at Lasalle, Illinois, through said Illinois River to Ottawa, Illinois, and said Board of Engineers shall make such report of said navigable waterways of seven and eight feet, respectively, of said Illinois River from Lasalle to Ottawa, Illinois.

By Special Orders, No. 19, Headquarters Corps of Engineers, Washington, July 5, 1902, a board to consist of Lieut. Col. (now Colonel) O. H. Ernst, Lieut. Col. Charles J. Allen, and Maj. Thomas L. Casey, all of the Corps of Engineers, was appointed to carry out the provisions of the act.

The Board met in Chicago, Ill., August 14, 1902, and after blocking out a plan of operations appointed Mr. J. W. Woermann, junior engineer, as their principal assistant, with instructions to organize and conduct the survey under their general direction. Mr. Woermann reported for duty in Chicago September 18, 1902, and proceeded to collect the necessary assistants, instruments, and material.

The undersigned was directed to disburse the money for the expenses of the survey.

By the middle of October the field work was begun at Grafton, Ill., in a reconnaissance for the secondary triangulation. By the middle of November the following parties were in the field, viz, one for secondary triangulation, one for tertiary triangulation, one for precise levels, one for wye levels, one for hydrography, and five for topography. Since that time the work has progressed as steadily as the weather and stage of river would permit. A boring party is to be organized hereafter.

In April, 1903, an office was established at Peoria, Ill., and the construction of the first sheets of the final maps was begun.

Gauge records are being kept at fourteen points on the river between Lasalle, Ill., and the mouth of the Illinois River.

High water discharge observations were taken during April and May at three points.

At the end of the fiscal year the advance parties had reached the neighborhood of Pekin, Ill., 152 miles from Grafton.

It is expected that the work can be completed sometime during the calendar year 1904.

For details of the work see report of Mr. J. W. Woermann, junior engineer, hereto appended.

#### *Money statement.*

July 1, 1902, balance unexpended .....	\$175,000.00
June 30, 1903, amount expended during fiscal year .....	47,539.15
July 1, 1903, balance unexpended .....	127,460.85

# 1906 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

REPORT OF MR. J. W. WOERMANN, JUNIOR ENGINEER.

U. S. QUARTER BOAT MARGARET,  
*Peoria, Ill., July 1, 1903.*

COLONEL: I have the honor to submit the following report on the work accomplished during the fiscal year ending June 30, 1903, on the survey of the Illinois and Des Plaines rivers.

The writer reported for duty at your office on September 18, 1902, and until your return to Chicago on September 24 spent the time in studying the reports and maps of previous surveys, corresponding with prospective employees, and preparing a project for the survey. On September 24 you approved my project and asked for the necessary authorities from the Chief of Engineers.

On September 25 I left Chicago for Kampsville, Ill., making a hasty reconnaissance of the Illinois River on the way down, inspected the available Government boats at Kampsville, and made arrangements with Assistant Engineer Brainard to have his men put in additional bunks, tables, etc., on quarter boats Nos. 1 and 2.

After returning to Chicago and selecting the serviceable property on hand from the last survey I submitted lists of the articles necessary to complete the equipment. After these were approved, proposals were issued for ranges, tools, dishes, furniture, mattresses, rubber boots, groceries, meats, oils, engine supplies, stationery, field books, drawing material, and transits.

The instruments and miscellaneous property that had been transferred to this survey from other districts were repacked, shipped to Kampsville and Grafton, and prepared for service. All of the transits were tested to determine the wire interval, and fifteen new stadia boards were graduated in sets of three each. Six skiffs were built by hired labor, and four were purchased. Two of the latter were of galvanized steel, and gave valuable service in the running ice during the winter.

In order to avoid duplication of topography or hydrography, I visited the office of the Mississippi River Commission at St. Louis, and found out what were the limits of their survey at the mouth of the Illinois River.

On October 13 Mr. Henry Fox arrived at Grafton, Ill., and began the reconnaissance for the secondary triangulation. The remainder of the triangulation party reported during the same week. On October 24 the two quarter boats and one commissary boat were towed from Kampsville to the mouth of the river by the tow-boat *Fbz*, and on the day following six additional parties were placed in the field. On November 12 the last instrument man reported, making the organization, as follows: One secondary and one tertiary triangulation, one precise and one wye level, one hydrographical, and five topographical parties.

The large amount of timber and brush, together with the numerous sloughs and wet condition of the bottom lands, made the progress at first rather discouraging. During the first part of December the field work was seriously interfered with by frequent rains, snow, and sleet. Later in the month the ice began to run, and steel plates and oak sheathing were placed on the hull of the *Pearl* to protect her from damage. Thus protected she was enabled to take the parties to and from work throughout the winter, with the exception of five days.

Early in January the soundings were discontinued temporarily on account of running ice. Bad conditions also retarded the secondary triangulation to some extent, but the frozen condition of the sloughs and marshes greatly accelerated the taking of topography. In the latter part of February, while at Montezuma, the river began to flood the lower lands in the bottoms, reducing the amount of territory which it has been possible to take since that time. Early in March the river reached a stage which was within 3 feet of the high water of 1892 and 1893, and within 7 feet of the high water of 1844, and it became necessary to suspend work on the tertiary triangulation and hydrography, and to lay off three of the topographical parties. The recorders taken from the fieldwork were detailed to draw contours on the field maps, and the observers to check the same, each party working on its own territory. The atmosphere was so hazy during most of this month that progress on the secondary triangulation was also seriously retarded.

On May 29 a rainy season set in which seriously interfered with the fieldwork, not only during the continuance of the showers, but by again flooding the bottom lands just as the river was returning within its banks after the spring rise. This second rise will result in an additional delay of at least six weeks before it will be practicable to return to Montezuma and again place the full force in the field. When this is done, the secondary triangulation and precise-level parties will be detached from the remainder of the force and continue their work up the valley independently.

A summary of that portion of the field and office work, which has been kept in tabulated form, is as follows:



*Secondary triangulation.*

Number of stations established .....	64
Number of stations occupied .....	61
Number of angles observed .....	226
Number of triangles adjusted .....	63
Number of sides computed .....	126
Number of stations, coordinates computed .....	61
Permanent monuments set .....	53
Prominent buildings located .....	25
Number of towers erected .....	14

*Tertiary triangulation..*

Number of stations established .....	249
Number of stations occupied .....	251
Number of angles observed .....	729
Number of triangles adjusted .....	253
Number of sides computed .....	498
Number of stations, coordinates computed .....	243
Number of base lines measured .....	16

*Precise levels.*

Miles of duplicate levels .....	137.9
Miles of single line, rerunning, etc. ....	52.3
Total miles of single line .....	328.1
Permanent bench marks established .....	44
Temporary bench marks established .....	205

*Topography.*

Number of stations occupied .....	6,905
Square miles of topography taken .....	290.1
Stones on section lines located .....	208
High-water marks determined .....	103

*Hydrography.*

Number of stations occupied .....	1,373
Sounding ranges established .....	1,110
Sounding ranges located .....	1,106
Number of ranges sounded .....	1,054

*Hypsometry.*

Miles of duplicate levels .....	165.5
Miles of single line .....	256.2
Total miles of single line .....	587.2
Bench marks established .....	258
Water gauges established .....	20
Sounding pegs determined .....	520

*Field maps.*

Triangulation stations plotted .....	270
Square miles of topography plotted .....	290
Ranges of soundings plotted .....	1,108
Bench marks plotted .....	291
Square miles of contours drawn .....	240
Square miles of contours checked .....	228.8

*Final maps.*

Triangulation stations plotted .....	92
Square miles of topography transferred .....	44.5
Square miles of topography inked in .....	23

The secondary triangulation was started from the secondary stations "Grafton" and "Rivermouth" of the Mississippi River system, and when completed will connect with the Lake Survey base at Chicago. Observations for azimuth and latitude were made at Hadleys Landing, Kampsville, Pearl, Valley City, Frederick, Bath,

# 1908 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

Havana, Pekin, and Peoria. Observations for time were made at Frederick, Bath, and Havana.

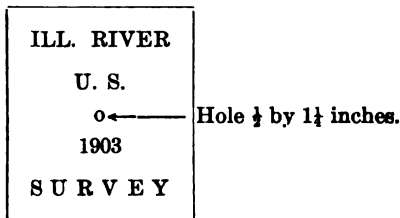
The following secondary base lines were measured: One, 6,000 feet long, on the Chicago and Alton Railway, between Pearl and Pegrim; one, 10,500 feet long, on the Wabash Railroad between Naples and Bluffs; one, 11,620 feet long, on the Chicago, Peoria and St. Louis Railway south of Bath; and a line 9,711 feet long on the Chicago, Peoria and St. Louis Railway south of Pekin.

The secondary angles were measured by the repeating method, as follows: Six times with telescope direct from A to B, six times reversed from A to B, six direct from B to A, and six reversed from B to A. After each set of six repetitions the limb was shifted about 60° to 90°. If the maximum and minimum values of the angle differed more than three seconds, two more sets were taken. The system of triangulation adopted was the triangular. The greater degree of precision possible with the quadrilateral system did not seem to justify the additional cost which would be entailed in a densely timbered valley. The limit of closure was six seconds, but about 50 per cent of the triangles closed within the primary limit of three seconds. Each target consisted of a pole about 3 inches in diameter and 8 feet long, carrying two to four squares of white muslin, supported by the same number of small sticks nailed crosswise on the pole.

During the first part of the work the angles were measured with a Berger & Sons transit having a 6½-inch limb, reading to twenty seconds. In order to make it possible to take longer sights and to observe for latitude by the method of zenith distances, a Saegmuller alt-azimuth instrument was purchased with an 8-inch limb reading to ten seconds, a 6-inch vertical circle reading to twenty seconds, a filar micrometer, and sensitive bubbles.

The precise levels have been carried on with the old Kern level, No. 1, using the same methods and limits of discrepancy as were used on the Mississippi River. The work is based on three permanent bench marks established by the Mississippi River Commission at Grafton, and when completed will connect with the Lake Survey at Chicago. The elevations refer to Memphis datum.

Permanent bench marks have been established about every 3 miles and temporary bench marks every mile. The permanent marks, for the precise levels and secondary triangulation, consists of stone blocks 18 inches square and 5 to 6 inches thick, made from Grafton limestone, marked as follows:



A copper bolt was leaded in the center of the block. The stones were set in holes 4 feet deep, and each is surmounted by a 3-inch wrought-iron pipe, 4 feet long, split at the bottom and spread, so as to offer resistance to being pulled out. A 2½-inch nipple prevents the dirt from coming through the two triangular spaces. Each pipe is covered with a bronze cap, fastened with two long rivets, bearing the following inscription:

## ILLINOIS RIVER SURVEY.

\$250 fine for disturbing this mark

1903

U. S.

Latitude

Longitude

Elevation above sea.

The instructions issued for the taking of topography, hydrography, and wye levels, and the platting on field maps, are submitted herewith as Appendix A. In addition to the information therein given it should be stated that all stadia notes were

checked before being plotted, and that the elevations were inked in on the field sheets as soon as plotted, so that there was no possibility of any of them being erased while the contours were being drawn. For the assistance of the parties in the field and the supervision of the same by the engineer in charge, tracings and blue prints were made from the latest county atlases obtainable of all the townships adjacent to the Illinois and Des Plaines rivers. The field books were printed to order with special headings for the various branches of the survey. Their use has resulted in economy of labor and uniformity of notes.

On April 1 an office was opened at Peoria, the necessary furniture installed, and work inaugurated on the final map. This is being drawn on sheets 42 inches wide and 12 feet long. The topography has been transferred to four of these by means of agate styluses and transfer paper coated with black lead.

Systematic gauge readings are being taken at sixteen points between Joliet and Grafton. Our records at present date from the beginning of this survey, but it is intended to make copies of all the gauge readings obtainable relating to the Illinois and Des Plaines rivers.

During the high water two sets of discharge observations were taken at Peoria, two at Beardstown, and two at Pearl, with Price current meter No. 15. As the results were not entirely satisfactory and the instrument was badly worn, the observations were suspended and the meter was sent to the makers for repairs.

Among the more important incidents connected with the survey the following probably deserve mention: Early in November the bottom timbers failed along one side of the commissary boat, and new ones were inserted to place her in proper condition. In the latter part of November the towboat *Fox* began to leak. She was taken to Kampsville, and with the consent of Assistant Engineer Brainard exchanged for the *Pearl*. On January 17 the quarter boats were towed from the Kampsville lock to the Chicago and Alton Railroad bridge at Pearl, Ill. While making a landing for cord wood the heavy shore ice cut a large hole in the rake of the office boat, but fortunately the opening was closed in time to prevent her from sinking. Several cases of smallpox having developed in the town of Pearl, the necessity for vaccination was impressed upon all the men engaged upon the survey, and all who had not been successfully vaccinated within the past three years submitted to the operation, with the exception of two, who were discharged.

During December and January complete plans were drawn for two quarter boats, tracings were made of the same, and proposals issued for the material. These were designed to take the place of those temporarily transferred to this survey by Maj. J. H. Willard. Great delay has been experienced in securing the delivery of the lumber, the railroads claiming that they were unable to bring the lumber north on account of the high water. Although the heavy lumber was ordered in December, it was not until the latter part of April that sufficient material was secured to permit the construction to be started, and it has been carried on only intermittently since that time. Both hulls have been completed, painted, and launched. On the double-decked boat the framework for the cabin has been erected, the drop siding put on, and the latter painted a priming coat.

As the progress on the new boats was so slow, there was transferred to this survey, about April 1, at my request, from the Missouri River Commission, the quarter boat *Margaret* and barge No. 108. Both boats were on the ways at Gasconade, Mo., and in need of repairs. About 2,500 feet B. M. of new lumber were placed in the hull of the *Margaret* and all of the seams recalced. When the barge was taken apart it was found to be in such bad condition that it became necessary to practically rebuild it. About 4,000 feet B. M. of new lumber were placed in the same, and the gunwales, bottom, and deck recalced. Both boats were then launched, and from May 7 to 13, inclusive, they were being towed from Gasconade, Mo., to Havana, Ill., by the U. S. towboat *Fox*.

While at Havana, Pekin, and Peoria the lower deck of the *Margaret* was entirely remodeled, so as to provide accommodations for 40 men. Some changes and additions were also made on the upper deck. The roof and outrigging were repaired, and the plumbing and steam-heating plant cleaned and repaired. The entire vessel was then repainted, both inside and out.

On June 9 and 10 a part of the force and equipment was transferred to the *Margaret*. The "commissary boat" and quarter boat No. 2, transferred to this work temporarily by Major Willard, were thoroughly cleaned, towed from Pekin to Kampsville, and returned to Assistant Engineer Brainard on June 13.

The miscellaneous supplies and property required during the year were purchased under competition whenever practicable. The usual reports were submitted, pay rolls prepared, accounts audited, vouchers prepared, cash statements rendered, and attention given to all routine clerical work.

## 1910 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

The following assistants have rendered faithful and efficient service: Junior engineers, Henry Fox, Fred Morley, John H. Best, F. B. Duis, Edmund Polk, Clarence A. Clement, F. C. Woermann, C. M. Waters, H. D. Harting; transitman, Chas. G. Weyl; draftsman, B. F. Davenport; clerk, G. C. Falconer; surveymen, T. C. Thogerson, W. N. Lundstrom, Oscar C. Bruszer, Chas. P. Hale, H. L. Mills, John D. Price, M. P. Blair, J. E. Walbridge, L. P. Peterson, Wm. H. Goodwin, R. L. Hauser, James C. Long, jr., J. D. Colton, and W. W. Reed.

Very respectfully, your obedient servant,

J. W. WOERMANN, *Junior Engineer.*

Col. O. H. ERNST,

*Corps of Engineers, U. S. Army, President Board of Engineers,*

*Waterway from Lockport, Ill., to mouth of Illinois River.*

### APPENDIX A.

#### GENERAL INSTRUCTIONS FOR FIELD WORK.

The object of this survey of the Illinois and Des Plaines rivers are to obtain sufficient data for an accurate topographical and hydrographical map, with contours 1 foot apart, which may be used in making plans and estimates for a 14-foot waterway from Lockport, Ill., to St. Louis, Mo., in determining the overflow which would be caused by an increased stage in the river, in studying the physical characteristics of the river, and as a basis for any future surveys. The importance of having the work done accurately, and the information embodied therein reliable, is therefore apparent.

The left-hand page of each note book should be numbered with the even numbers; on the right-hand pages the numbers may be omitted. The date, last name of the observer, and last name of recorder should be written in all the blank spaces provided for that purpose. The general locality should be given briefly on each page in names familiar in that vicinity. The initials and number of instrument should be given at the beginning of each day's work. Three pages should be reserved at the beginning of each book for an index.

In recording notes only 3 H. Hardmuth pencils will be used, and when an entry has once been made it should never be erased. When an error has been made the record will be corrected by drawing a line through the first value, and writing a new value above it. Corrections that are made after the work is done should be marked with the date of change and the name of the person making the change.

All notes should be full and plain, so that they can be checked by any person in the office. They should be accompanied by sufficient sketching to enable any draftsman to plat the notes readily, even though he has not seen the ground. This will require careful attention to details which may seem of little importance in the field. Local names of bars, bends, streams, islands, landings, ferries, or other features will be carefully noted, and in the case of dwellings the names of the owners should be secured, care being taken in every case to obtain the proper spelling.

#### INSTRUCTIONS FOR TOPOGRAPHICAL WORK.

(1) The detailed topography will extend approximately from the high-water line of 1844 on one side of the valley, to the same line on the opposite side. If the bluffs or hills are within 1,000 feet of this line, a few readings should be taken to locate the hills also. In this area there will be located, with transit and stadia, all points needed to plat accurately the important features to a scale of 1 inch to 400 feet. In all work the scale of the plat should be borne in mind so that only such points be instrumentally located as can be readily platted.

(2) Within the limits of the detailed area there will be located the top of the river bank proper, the shore lines of islands and bars, the banks and water lines of all waterways, lakes, sloughs, and streams, with elevations of their water surfaces, and depths; the points where the slope of the ground changes either in direction or inclination, the limits of timber and rock ledges, approximate limits and kinds of cultivation, together with the location of all roads, railroads, levees, fences, houses, bench marks, and other objects that may be necessary to a truthful representation of the valley. (The bottom of the river bank proper and the water edges will be located by the sounding party.) In towns the buildings close to the river bank will be located, but farther back the corners of the blocks will be sufficient. Full details shall be taken of the piers, revetments, and trusses of all bridges crossing the river, together with complete sketches of the same.

(3) Boundary lines such as State, county, township, etc., coming within the limits of the survey will be carefully located, and special efforts should be made to find and locate section corners. The topographers as well as the levelers should make frequent inquiry in regard to high-water marks, and determine their elevation whenever the information seems to justify it. Whenever a landmark or high-water mark is located or determined, the recorder shall enter the same promptly in the special books kept for that purpose.

(4) In ordinary country the stadia lines should be run approximately half a mile apart, and readings taken to a distance of 1,000 or 1,200 feet on each side of the stadia line. In open country the side shots should be about 300 feet apart in each direction, and preferably parallel to fence lines. In the absence of fences the stadia men should operate along rectangular lines so as to obtain elevations as uniformly as possible. In other words, where possible, the territory will be divided, approximately, into 300-foot squares. When the sloughs are frozen, it will expedite the work usually to run transit lines on the ice, and locate the shore line from stations on the ice.

(5) In densely wooded areas, in order to keep the cost per square mile within reasonable limits, the elevations may be taken on cross-section lines 500 to 1,000 feet apart, depending on the thickness of the timber and brush and the character of the country. The territory between these cross-section lines should be examined, however, and if any important features are found they should be located. If the surface of the ground is irregular the contours should be sketched in the notebook.

(6) The subject of "General topographical surveying," as found in Johnson's "Surveying" (pp. 257 to 268 of the last edition), should be reviewed carefully, and the practice therein indicated be followed wherever applicable. The sketches should be made by the recorder, but the observer should satisfy himself that the work is being done properly. The sketches should in no case be omitted, and the recorder need have no fear that he will include too much data.

(7) In carrying elevation from station to station, the direct reading, obtained by making the telescope horizontal and using the stadia board as a level rod, should be taken when possible, as well as the vertical angle. In case the error of level, as carried by vertical angles, should exceed the limit of 0.5 feet, the direct readings would probably locate the mistake. If not, the leveler will be instructed to connect with the questionable stations. The work should be checked frequently by reading on points whose elevations are known.

(8) When a circuit is closed and it becomes necessary to distribute the error in elevation back through a number of stations, the adjusted elevations should be written in red ink just above the original determination. Likewise all elevations determined by wye levels shall be written in red ink with the letter "L" immediately following. The elevations of stadia stations shall be computed to the nearest hundredth, and of side shots to the nearest tenth of a foot.

(9) The distances between stations should never exceed 1,500 feet. Whenever it is necessary to read the upper and lower interval separately, the addition should be performed on the same line on the right-hand page. Single shots to distant points may be read up to 2,000 feet in special cases. When a circuit is platted the error in distance should not exceed 1 in 500.

(10) The transit stations will consist of hard wood hubs, not less than 2 by 12 inches, cut by the axman and driven nearly flush with the ground. The pine stakes kept in stock on the quarter boats will be used for marking stakes. Each observer will number his stakes consecutively, followed by his initial, so that they can be readily identified by others. When 1,000 stations have been set a new series will be started.

(11) Checks on azimuth should be frequent, and when taken should be marked in the notebook in such a way that the amount of error will be plainly shown and where the correction should be applied. Notes that are not full in this particular will always be open to suspicion, which will throw doubt on the observer's honesty and the reliability of his work. Azimuth should be checked frequently by letting down the needle; this will readily detect any error exceeding 1 degree. Discrepancies in closing on triangulation stations should never exceed  $0^{\circ} 05'$  in azimuth.

#### HYDROGRAPHY.

Sounding lines will be run normal to the stream at intervals of about 500 feet, and the soundings on these lines should be about 50 feet apart. These lines will be numbered consecutively.

The sounding flags will be located on one side of the river by transit and stadia, and on the opposite side by intersection, at least three pointings being taken on each flag. A sounding peg will be established at each alternate range, the elevation of which will be determined by the wye levelman. When the soundings are taken,

## 1912 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

the recorder in the skiff will note the distance from the top of the peg to the water surface.

The sounding boat should be kept on a straight line between the sounding flags, and the location of the leadsman be determined at every third sounding by intersection with the transit from a located point on shore. The recorder on shore and the recorder in the boat should each record the time of each intersection, the steersman giving the signal with the flag. The angles read to locate soundings will be numbered consecutively for each line sounded, and the soundings located will be marked with corresponding numbers by the recorder in the boat. Intermediate soundings can be interpolated by taking them at equal intervals of time.

In water less than 12 feet deep a sounding pole should be used, divided to feet and tenths, and at a greater depth a 6½-pound lead, attached to a braided cotton lead line five-sixteenths inch diameter, should be used. The 10-foot marks should be indicated with leather tags notched similarly to the tags on an engineer's chain, the 5-foot marks by plain leather tags, and the 1-foot marks by strips of cloth. The tenths can be estimated. The length of the lead line from the end of the lead to each 10-foot mark must be determined at the beginning and end of each day's work and the result entered in the notebook. If the discrepancy becomes more than 1 foot in 30 the line should be retagged. The necessary correction shall be applied when the soundings are reduced to a low-water basis.

The limit for distance between the transitman and the sounding cutter shall be six ranges, or about 3,000 feet.

### ORDINARY LEVELS.

[Based on instructions issued by Mississippi River Commission.]

There will be a line of wye levels run along each bank of the river connecting with all triangulation hubs, and also with stadia hubs whenever they can be readily reached. Each leveler will number his turning points consecutively so that topographers can readily identify any point connected with.

Each wye-level line will connect with all precise bench marks on the same side of the river, unless there is some special reason for not doing so. The elevation, as determined by the precise levels, will be used in continuing the levels beyond that point. The error of closure should not in any case exceed 0.2 feet in 5 miles. The two wye-level lines should check on each other at intervals of not more than 3 miles. The adopted elevation of these checking points will be the mean of the two determinations.

Bench marks will be established on each line of levels at intervals of about a mile. These may be placed on buildings, trees, or other prominent objects. A careful description and sketch of location of each bench mark will be made in the notebook. These notes should be in sufficient detail to permit of their being platted on the maps, and to enable one not familiar with the ground to find them even after the lapse of many years' time.

All water gauges will be connected with by duplicate lines of levels from the nearest bench marks, and the elevation of their zero points entered in the gauge book.

The elevation of the sounding peg and water surface will be determined at one extremity of every alternate sounding line, and the time of the observation entered in the notebook. This, when corrected for change of stage, as shown by the local gauge readings, will give the slope, and also serve to check large errors in leveling.

River crossings will be made by taking five sets of readings across the river in opposite directions. The instruments should be in good adjustment and when once focussed for the long distance should not be changed until the observations are completed. The mean of the values thus determined will be taken as the true value.

Frequent inquiries should be made in regard to high-water marks, and their elevation determined whenever the information seems to be reliable enough to justify it. The notes should indicate the year of the high water, the name of the party furnishing the information, and the general location of the mark, so that the point can be platted approximately, and its distance from the mouth determined after the completion of the maps.

### INSTRUCTIONS FOR PLATTING ON FIELD MAPS.

The coordinates of all Secondary and Tertiary triangulation stations will be computed, and will form the basis for platting topographical and hydrographical detail. The result of these computations will be kept in suitable form and preserved for future reference.

The work will be platted on a scale of 1 inch to 400 feet. The field plats will be

22 by 30 inches in size on which, near the center, will be printed a 12-inch circle, divided to 15-minute spaces to facilitate the platting of polar coordinates.

Parallels and meridians, 2,000 feet apart, will be projected on the field plats and shown by fine red lines properly numbered. From these the triangulation stations will be platted. As this is the groundwork for subsequent detail, it should be carefully done and checked over to insure its accuracy. All triangulation stations, stadia stakes, and sounding flags should be marked on the plats in red ink before the detailed work is put in.

The main stadia line will be platted by transferring azimuths from the printed protractors by means of parallel rulers. If the main stadia line closes properly on a located point, then the "side shots" at each stadia station will be platted with a 12-inch Ockerson protractor, made of transparent celluloid, as described on page 273 of Johnson's Surveying. Six-H Hardmuth pencils will be used in platting.

Before the contours are drawn each observer will inspect his own work on the field sheets, and when satisfied of its correctness shall ink in all fences, roads, creeks, levees, etc. His recorder shall then draw the contours, which shall in turn be checked by the observer. Where the ground is too steep to admit of 1-foot contours, only the 5-foot contours shall be drawn, and where the slope is too steep for 5-foot contours then hachures shall be used.

Each field plat will bear a fractional number indicating its position on the index sheets; also the names of the observers and recorders who drew the contours. In the notebooks each draftsman will indicate what pages were platted by him.

Care must be taken at the edges of the sheets to have the detail on successive plats join properly, and make sure that the ground is fully covered by the survey.





## APPENDIX N N.

---

### IMPROVEMENT OF ILLINOIS RIVER, ILLINOIS, AND CONSTRUCTION OF ILLINOIS AND MISSISSIPPI CANAL.

---

*REPORT OF MAJ. J. H. WILLARD, CORPS OF ENGINEERS, OFFICER  
IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1903, WITH  
OTHER DOCUMENTS RELATING TO THE WORKS.*

#### IMPROVEMENTS.

- |   |                                    |
|---|------------------------------------|
| 1. Illinois River, Illinois.  | 3. Illinois and Mississippi Canal. |
| 2. Operating and care of Lagrange and<br>Kampeville locks, Illinois River, and<br>approaches thereto. |                                    |
- 

UNITED STATES ENGINEER OFFICE,  
*Chicago, Ill., July 10, 1903.*

GENERAL: I have the honor to transmit herewith annual reports upon  
works in my charge for the fiscal year ending June 30, 1903. \* \* \*

Very respectfully, your obedient servant,

J. H. WILLARD,  
*Major, Corps of Engineers.*

Brig. Gen. G. L. GILLESPIE,  
*Chief of Engineers, U. S. A.*

---

## N N I.

### IMPROVEMENT OF ILLINOIS RIVER, ILLINOIS.

WORK DONE DURING THE FISCAL YEAR ENDING JUNE 30, 1903.

Owing to extremely high water during the season of 1902 and the spring of 1903 operations have been practically suspended. The river has been out of its banks much of the time, rendering it necessary to load lumber and loose property on barges to prevent its being carried away. The plant has been maintained and repaired, and a shop built for protection of a saw and planer.

Report of Assistant Engineer C. V. Brainard is herewith.

#### PROPOSED APPLICATION OF FUNDS ON HAND.

It is proposed to apply these funds to maintaining the navigable channel of 7 feet depth between Copperas Creek dam and the mouth

# 1916 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

of the river, widening the same to 200 feet, removing snags, dredging a channel through the bar at mouth of Macoupin Creek, care and repair of plant and property, and in making such local surveys as may be necessary from time to time.

## Money statements.

July 1, 1902, balance unexpended .....	\$90,775. 41
June 30, 1903, amount expended during fiscal year .....	10,171. 93
July 1, 1903, balance unexpended .....	80,603. 48
July 1, 1903, outstanding liabilities .....	500. 00
July 1, 1903, balance available .....	80,103. 48
Amount (estimated) required for completion of existing project.....	182,000. 00

## APPROPRIATIONS.

June 30, 1880, available from previous appropriations .....	\$38,337. 81
Act of—	
June 14, 1880 .....	110,000. 00
March 3, 1881 .....	250,000. 00
August 2, 1882 .....	175,000. 00
July 5, 1884 .....	100,000. 00
August 5, 1886 .....	112,500. 00
August 11, 1888 .....	200,000. 00
Joint resolution September 29, 1890 .....	200,000. 00
Act of—	
July 13, 1892 .....	100,000. 00
August 18, 1894 .....	35,000. 00
June 3, 1896 .....	40,000. 00
March 3, 1899 .....	100,000. 00
June 3, 1902 .....	75,000. 00
Received from all other sources .....	1,535,837. 81
	535. 40
Total .....	1,536,373. 21
Expended to June 30, 1903 .....	1,455,769. 73
Balance unexpended June 30, 1903 .....	80,603. 48

## COMMERCIAL STATISTICS.

Arrival and departure of steamboats at St. Louis, Mo., via Illinois River, calendar year 1902.

Month.	Arrivals.	Departures.	Month.	Arrivals.	Departures.
January .....			August .....	12	10
February .....			September .....	13	10
March .....	10	13	October .....	16	10
April .....	10	8	November .....	10	10
May .....	9	12	December .....	5	2
June .....	10	10	Total .....	107	99
July .....	12	14			

	Tons.
Receipts .....	19,811
Shipments .....	10,540

## REPORT OF MR. C. V. BRAINARD, ASSISTANT ENGINEER.

KAMPSVILLE, ILL., June 30, 1903.

MAJOR: I have the honor to submit the following report of operations for improving Illinois River for the fiscal year ending June 30, 1903:

The year has been exceptional as regards high water. The river was rising at the end of the previous year and continued rising until the bottoms were completely submerged. The river was out of its banks until the 1st of September and continued at a high stage during the remainder of the season. The 1st of March another rise occurred and until the present time water has been over the banks continually.

Three different times during the fiscal year it has been necessary to load on barges or pile up where practicable all the lumber, blocking, and other loose property, both in the buildings and outside, to prevent the high water from carrying it away or destroying it.

No work has been done except slight repairs to plant.

The old hull of the towboat *Marion* was measured, plans drawn, patterns for the timbers and bow stem gotten out, and the latter made.

A shop 18 by 50 feet was built for a saw and planer and a portable engine fitted up to run them.

Barges Nos. 1, 2, and 3, calked all the seams above light water.

Barge No. 4, hauled out and calked all gunwale and rake seams.

Scow No. 3, calked the pocket decking.

Office boat, renewed planking on the guards.

Steamer *Pearl*, calked all seams above light water.

Steamer *Fox*, hauled out and calked gunwales.

Very respectfully, your obedient servant,

C. V. BRAINARD, Assistant Engineer.

Maj. J. H. WILLARD, Corps of Engineers.

\* \* \* \* \*

## N N 2.

## OPERATING AND CARE OF LAGRANGE AND KAMPSVILLE LOCKS, ILLINOIS RIVER, AND APPROACHES THERETO.

These locks and dams have been operated and maintained under the indefinite appropriation provided by section 4 of the river and harbor act of July 5, 1884.

The accompanying report of Asst. Engineer C. V. Brainard contains tables showing the number of boats navigating the river, the number of times they have passed the locks during the past fiscal year, and the tonnage of various classes of goods.

*Summarized statement of expenses from allotment for operating and care of canals and other works of navigation, indefinite, applied to Lagrange lock and Kampsville lock, Illinois River.*

## Lagrange lock:

Services .....	\$5, 770. 59	
Traveling expenses .....	17. 56	
Materials .....	88. 87	
Supplies .....	15. 53	
Freight .....	. 60	
Property .....	9. 50	
		\$5, 902. 65

## Kampsville lock:

Services .....	5, 360. 50	
Telephone .....	21. 00	
Material .....	34. 74	
Supplies .....	46. 12	
Property .....	46. 45	
		5, 508. 81

Total ..... 11, 411. 46

# 1918 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

## Money statements.

### LAGRANGE LOCK.

July 1, 1902, outstanding liabilities.....	\$484. 50
July 1, 1902, allotment for year 1903.....	10, 000. 00
	<hr/>
June 30, 1903, amount expended during fiscal year .....	10, 484. 50
	<hr/>
July 1, 1903, balance unexpended.....	4, 581. 85

### KAMPSVILLE LOCK.

July 1, 1902, outstanding liabilities.....	416. 79
July 1, 1902, allotment for year 1903.....	10, 000. 00
	<hr/>
June 30, 1903, amount expended during fiscal year .....	10, 416. 79
	<hr/>
July 1, 1903, balance unexpended.....	5, 508. 81
	<hr/>
	4, 907. 98

### COMMERCIAL STATISTICS FOR FISCAL YEAR ENDING JUNE 30, 1903.

	Passing La- grange lock.	Passing Kampsville lock.
Steamboats.....number..	519	311
Barges.....do.....	242	94
Tonnage of steamboats.....	114, 067	99, 875
Tonnage of barges.....	31, 422	10, 948
General merchandise.....tons..	2, 750	5, 190
Passengers.....number..	14, 664	8, 392
Stock.....head.....	2, 049	20, 040
Corn.....bushels.....	159, 075	23, 506
Wheat.....do.....	162, 400	182, 615
Other grain.....do.....	5, 425	3, 575
Apples.....barrels.....	8, 124	19, 140
Logs and lumber.....feet B. M.....	655, 750	150, 000
Ties.....number.....		3, 700
Wood.....cords.....	856	200
Coal.....tons.....	270	47
Stave bolts.....cords.....	280	

### List of boats navigating the Illinois River during the fiscal year ending June 30, 1903.

Name.	Tonnage.	Times passed—	
		Lagrange lock.	Kampsville lock.
Bald Eagle.....	590	137	141
Grey Eagle.....	555	6	6
J. S.....	236	12	6
Illinois.....	254	25	8
City of Peoria.....	128	29	12
Annie Russell.....	132	2	2
Borealis Rex.....	116	1	1
G. M. Sivley.....	99	5	1
Eleonore.....	97	78	28
John H. Kirby.....	99	1	1
Little Clyde.....	99	2	2
Argand.....	96	2	2
Imperial.....	96	19	8
Speed.....	85	1	1
Jacob Richtman.....	327		4
City of Henry.....	67	4	
Marguedora.....	57	1	1
Antoinette.....	55	2	2
Mary.....	50	52	19
Ebaugh.....	50	16	

# APPENDIX N N—REPORT OF MAJOR WILLARD. 1919

List of boats navigating the Illinois River during the fiscal year ending June 30, 1903—C't'd.

Name.	Tonnage.	Times passed—	
		Lagrange lock.	Kampeville lock.
Eva Alma .....	48	2	1
H. W. Longfellow .....	47	12	..
Juliette .....	44	2	2
John H. May .....	42	1	1
Vernon, jr. ....	33	2	2
Edith K. ....	25	3	..
Elk .....	20	1	..
R. G. Schmoldt .....	19	38	..
Ouataga .....	15	..	4
Richmond .....	15	1	..
Belle of Ottawa .....	11	4	3
Mercury .....	11	1	1
Cero .....	24	1	1
R. D. Clark .....	9	1	1
Kid .....	7	1	1
Mary Mc. ....	8	2	2
Anti .....	10	1	..
Lily .....	206	2	2
Yankee .....	5	..	6
Virginia .....	8	..	4
Thusmelda .....	5	2	6
Celine .....	5	4	..
Glaser .....	5	2	..
Illolo .....	5	..	2
Little Dick .....	4	15	2
Myrtle .....	4	2	..
Viodelia .....	4	..	4
Bimini .....	4	4	..
City of Bath .....	4	8	..
Actea .....	4	4	6
Edma .....	4	..	5
I. S. M. ....	4	1	..
Bo-Peep .....	4	5	1
Nellie Bly .....	3	4	..
Julia West .....	5	..	2
Josie Mae .....	4	..	2
R. Poe .....	4	..	2
Cricket .....	4	2	2

## REPORT OF MR. C. V. BRAINARD, ASSISTANT ENGINEER.

Kampeville, Ill., June 30, 1903.

MAJOR: I have the honor to submit the following report of operating and care of locks and dams, Illinois River, for the fiscal year ending June 30, 1903:

### LAGRANGE LOCK AND DAM.

Navigation continued by this lock during the entire year except in January, when it was suspended the entire month because of floating ice. During July and August, 1902, and March and April, 1903, all but three boats passed over the dam; during May and June about one-third of the boats used the lock; during the remainder of the year the lock was used by all the boats except a few during the last of October and the first of November, 1902.

The ice breaker above the lock was repaired by bolting down the cutting edge and protecting it by iron straps.

The piles supporting the river wall spar-track platforms having rotted, the platforms were rebuilt, using suspended beams to carry them instead of supporting them by piling.

### KAMPEVILLE LOCK AND DAM.

Navigation was suspended from December 20, 1902, to March 9, 1903, because of running ice. During July and August the lock was used but by four boats, the rest passing over the dam; during March, April, May, and June, 1903, all boats passed over the dam except from May 18 to 28 during which time all boats used the lock; the rest of the year the lock was used all of the time.

The ironwork about the lock was painted twice and the buildings and grounds kept in order. The deposit of mud left by the high water above the gates was cleaned out so the gates would work freely.

## 1920 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

### TONNAGE.

There are herewith two tables, one showing the traffic by each lock for the fiscal year, the other showing the boats navigating the river and the number of times each passed the locks.

Very respectfully, your obedient servant,

C. V. BRAINARD, *Assistant Engineer.*

Maj. J. H. WILLARD, *Corps of Engineers.*

---

### N N 3.

#### ILLINOIS AND MISSISSIPPI CANAL.

Extraordinary rains fell last season throughout the territory traversed by the canal, and the season closed with streams and drainage ditches bank full. This season opened fair, but this district suffered from high water again in May, which drains off slowly on account of the high stages of Green and Rock rivers. All work has been greatly delayed, except in the high grounds, and the contractors have been interrupted so often that it is doubtful if any of the work can be finished till late this year.

The contractor for aqueduct foundations has lost plant and material, and the work must be taken up by the bondsmen or else the United States must take hold of it.

Severe damages have been done to earthwork already finished and accepted, the greater part being on the eastern section, due to the proximity of Bureau Creek and its branches, where several crevasses occurred. Complaints have been made by quite a number of owners along the line of the canal and feeder of injuries, all of which are charged to the canal, but investigation does not show this to be true, except on the feeder where there is evidence that protective structures had been wilfully destroyed to turn water from farm lands or district ditches into the canal. It is a fact that heavy rains prevailed throughout the State, and that large areas of lowlands distant from the canal were flooded to quite as great a degree.

*Eastern section.*—Work on this section has consisted in repairing damages on miles 2 to 11, inclusive, and maintenance of banks, bridge approaches, improving drainage, building bridge abutments, cleaning up the miles abandoned by the Globe Construction Company, and preparing for the construction of the canal trunk through the flowing material and peat bog known as Cecil's slough, from mile 20 to 24, by hired labor and purchase of special plant.

All of the highway bridges from 11 to 18 are under contract and in process of erection. There are disputes as to certain farm bridges which it is claimed were promised or ordered by the courts, but no records of such bridges are known, except near Lock 21, where it is proposed to put a bridge on the tail bay of the lock.

The work on this section during the next fiscal year will consist of maintenance and the construction of canal trunk from mile 19 to mile 25 and completing the erection of all bridges and of approaches and roadways. All of the earthwork has been completed on miles 1 to 19,

about 95 per cent of mile 19 is finished and 60 per cent of mile 20; about 95 per cent of miles 24 and 25 and about 97 per cent of miles 26, 27, and 28 to the feeder junction. All of the masonry for locks, culverts, aqueducts, and highway and railway bridges has been finished.

For details reference is made to the report of Asst. Engineer James C. Long, herewith.

*Western section.*—All earthwork from the junction of the feeder to mile 53, and for miles 58 and 59, has been done or is under contract. Nineteen miles are entirely finished, and 2,831,013 cubic yards of earthwork have been excavated. The deep cut at and below Colona and the embankments to Rock River, miles 60, 61, and 62, are being executed by hired labor and plant owned by the United States, consisting of steam shovel and railway equipment, and gratifying progress has been made. Raising the tracks of the Rock Island Railway and the construction of abutments and bridge over the canal near Colona have been placed under contract with the railway company. Satisfactory agreements have been made for the new line and railway bridge for the Burlington road where it crosses the canal and the Rock Island road west of Colona. The remaining earthwork, miles 53 to 57 inclusive, must await the completion of the work west of mile 57 and of the aqueduct over Green River, but the culverts and bridge abutments in this section have been finished.

All the rest of the masonry on the western section, bridge abutments, foundations and superstructures of locks, and foundations and piers for aqueducts, and arch and pipe culverts, have been finished or put under contract except for three bridges. All highway bridges except six have been placed under contract. Of the six, two are of special design to be placed on the tail bays of locks, one a plate girder and the other a lift bridge, and four have been recommended for award on recent bids. It has not yet been decided whether to build the abutments and contract for the superstructure of the Burlington Railway Bridge or contract with that company for the work, as in the case of the Rock Island Railroad.

For details reference is made to the report of Asst. Engineer L. L. Wheeler, herewith.

*Feeder.*—The principal work on this section during the year has been the excavation of rock in the canal prism of mile 1 and distributing it as riprap along the slopes on each side southward. This work has been well done and has been most advantageous to the canal. There can be no doubt as to the question of economy, for it would have cost a large sum to have piled the material near mile 1, requiring the purchase or renting of a considerable area for storage, and the cost of hauling and depositing in a high mound probably would have equaled that of hauling on a level and dumping on the slopes. The revetment would have been necessary in any event, as has been stated in frequent reports, and has been of great value in preventing wash during the wet season of last summer and this spring. It will be continued later when the steam shovel and railway material are returned from Colona.

All of the earthwork has been finished to the junction with the main canal, except at certain highway crossings which can not be closed until the bridges are built. None of these, except No. 44 on the Dixon road, and two railway bridges for the Burlington road, have been built, awaiting final action upon the injunctions issued by a State court in

September, 1900. The cases were dismissed in May, 1903, for want of jurisdiction. But the appellants having given notice that a motion would be made to enforce the decree in the original awards for right of way, it was thought best not to resume work on any of the bridges across the feeder.

The delay is very inconvenient to all concerned, prevents the United States from closing gaps in the embankments, makes the temporary crossings unsafe, and interferes with the progress of the work generally, especially that for the aqueduct over Green River.

All other masonry on the feeder, lock, and controlling works at the head, and arch and pipe culverts, have been finished. Gates for the flushing culverts await decision as to standard forms.

The dam in Rock River will be about 1,300 feet long, instead of 400 feet, as was estimated for the Dixon feeder. It was ordered by decree of court in awards for flowage damages to be movable. Assistant Engineer Wheeler has worked out a design for an overhead bridge from which are suspended vertical frames in pairs to hold sliding Boulé gates, giving 8 feet head on the sills. I have suggested amendments in reducing the length of spans, raising the sills, and making the three middle spans hydraulic gates, the central a bear trap, and those on each side gates designed by Major Marshall. The details are now in the hands of the draftsman. A lock and sluiceways have been designed in the dam pursuant to suggestions which appeared in two successive river and harbor bills, but for which no additional money was provided. The matter ought to be decided so that both works can be done with the same cofferdams.

A special lift bridge has been designed and approved for the highway crossing the canal at the guard lock and controlling works, and will be put in hand with the similar bridge on the western section.

For details reference is made to the report of Asst. Engineer L. L. Wheeler, herewith.

*General remarks.*—The past year has been an exceedingly discouraging one as already stated, both on account of excessive rainfall and the continued interference with the United States with respect to highway bridges over the feeder.

It does not seem probable that the canal can be finished for service for at least three years, and the circumstances which will cause the delay are not considered by those who are impatient to see the canal of service. After the experience of three years on its construction, I am of the opinion that all connected with the work have been zealous in the discharge of the duties intrusted to them, and have worked hard to hasten its construction. There has been but one dry season since 1899, and the litigation in regard to bridges over the feeder has been going on since September, 1900, from which date of course no work has been done on the bridges in question or could be undertaken with safety on any others on the feeder. All the work of every class has been done in the most thorough manner, is not surpassed by any similar work of construction in the United States, and has been highly commended by engineers from abroad, as well as at home, who have inspected it.

What remains to be done should be continued on the same high standard, and therefore again I invite earnest attention to the special report of Maj. William L. Marshall, dated December 16, 1896 (Report Chief of Engineers, 1897, p. 2867), and to my special report of Janu-



ary 6, 1902 (Report Chief of Engineers, 1902, p. 2121), upon the subject of additional funds to make the canal of practical use for canal boats and barges of large capacity whether with steam or animal traction.

*Money statement.*

July 1, 1902, balance unexpended .....	\$1, 880, 633. 21
June 30, 1903, amount expended during fiscal year .....	380, 152. 62
July 1, 1903, balance unexpended .....	1, 500, 480. 59
July 1, 1903, outstanding liabilities .....	20, 000. 00
July 1, 1903, balance available .....	1, 480, 480. 59
July 1, 1903, amount covered by uncompleted contracts .....	582, 629. 53

APPROPRIATIONS.

July 1, 1890, balance unexpended from previous appropriations .....	\$786. 46
Act of—	
September 19, 1890 .....	500, 000. 00
July 13, 1892 .....	500, 000. 00
August 17, 1894 .....	190, 000. 00
June 3, 1896 .....	45, 000. 00
Sundry civil act, June 4, 1897 .....	875, 000. 00
Sundry civil act, July 1, 1898 .....	1, 427, 740. 00
Sundry civil act, March 3, 1899 .....	700, 000. 00
Sundry civil act, June 6, 1900 .....	1, 000, 000. 00
Sundry civil act, March 3, 1901 .....	975, 000. 00
Sundry civil act, June 28, 1902 .....	733, 220. 00
Total .....	6, 946, 746. 46
Expended to June 30, 1903 .....	5, 446, 265. 87
Balance unexpended, July 1, 1903 .....	1, 500, 480. 59

*Expenditures, Illinois and Mississippi Canal, for fiscal year 1903.*

Eastern section, Illinois River to Feeder Junction .....	\$86, 169. 09
Western section, Feeder Junction to Rock River .....	223, 380. 45
Feeder line .....	70, 603. 08
Total .....	380, 152. 62

*Total expenditures, Illinois and Mississippi Canal, to end of fiscal year 1903.*

Eastern section .....	\$2, 599, 269. 02
Western section:	
Around rapids of Rock River .....	547, 229. 93
Rock River division .....	25, 470. 21
Feeder Junction to Rock River .....	895, 892. 44
Feeder line .....	1, 378, 404. 27
Total .....	5, 446, 265. 87

# 1924 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

## List of contracts in force during fiscal year ending June 30, 1903.

Name and address of contractor.	Nature of contract.	Date.	To expire.
Pound Construction Co., Chicago, Ill.	Earthwork mile 34, western section.	Sept. 1, 1900	Sept. 30, 1901
T. W. Kinser & Sons, Terre Haute, Ind.	Earthwork miles 50-52, western section.	May 10, 1901	Dec. 31, 1901
Katz & Callahan, Omaha, Nebr.....	Earthwork mile 49 and new channels.	.....do.....	Do.
John J. McCaughey, Chicago, Ill....	Earthwork miles 29, 30, and 32, western section.	Sept. 12, 1901	Oct. 19, 1902
Katz & Callahan, Omaha, Nebr.....	Earthwork mile 31, western section.	.....do.....	Oct. 20, 1902
Chicago Bridge and Iron Co., Chicago, Ill.	Superstructures 21 highway bridges	Mar. 27, 1902	Dec. 31, 1902
Wallace Marshall, Lafayette, Ind...	Superstructures 6 highway bridges	Apr. 10, 1902	Do.
Cogan & Pound, Chicago, Ill.....	Pits and foundations for 2 locks and 4 culverts.	Apr. 2, 1902	Nov. 30, 1902
Chas. Stone, Des Moines, Iowa.....	Pits and foundations 4 aqueduct bridges.	Mar. 20, 1902	Do.
Callahan Bros. & Katz, Omaha, Nebr	Earthwork miles 58 and 59, western section.	July 16, 1902	July 31, 1903
Page & Shnable, Chicago, Ill.....	Foundations and walls for locks and piers and abutments for bridges, western section.	Aug. 11, 1902	Nov. 30, 1904

### REPORT OF MR. L. L. WHEELER, ASSISTANT ENGINEER.

STERLING, ILL., June 30, 1903.

MAJOR: I have the honor to submit the following report upon the work done on the Illinois and Mississippi Canal, under my supervision, during the fiscal year ending June 30, 1903:

#### FEEDER.

At the beginning of the year rock excavation on mile 1, by means of steam shovel and trains of dump cars, was in progress. This work was continued until into December, when all the rock which could now be removed was excavated except several hundred yards left for the purpose of being crushed for concrete purposes. As near as can be estimated, 75,000 cubic yards of rock were excavated in all by the steam shovel, at a total cost of \$33,570.36 for labor, explosives, fuel, oil, waste, and other miscellaneous expenses, and a charge of \$4,126.03 for property, or a cost per cubic yard of 44.76 cents.

As estimated by car measurements, this amount of rock made 121,050 cubic yards of riprap, which was distributed along the feeder and dumped on the interior slopes at a total cost of \$48,699.94, or a cost per cubic yard of 40.23 cents. This cost includes a charge of 25 cents per cubic yard for the railroad along the feeder. It is expected to distribute the remaining cost of the railroad to structures and other works. Two 3-yard carloads were dumped in the length of a car, approximately 11 feet. The riprap extended on the east side of the feeder to the middle of mile 19, and on the west side of the feeder to about the end of mile 22. In front of highway bridges upon which no work had been done three carloads were dumped, it being the intention that the riprap should take the place of slope paving at other bridges.

Should the construction of the lock in the dam at the head of the feeder and the excavation of the channel leading into it be entered upon at some future time, this rock can be used in riprapping part of the remaining banks of the feeder. The crushing plant has been operated and crushed the stone used for the guard lock at the head of the feeder. Also a large quantity has been stored for the construction of the dam in the river, and at present stone is being hauled to Green River by train for the aqueduct to be built across that stream.

During the last season, which was a very wet one, many complaints were received in regard to the culverts along the feeder. At Culverts Nos. 1 and 8 plank and earthen cofferdams had been constructed in lieu of permanent gates in the openings for flushing the culverts, so as to force the water to pass through the culverts and continue in the proper drainage lines. When the water was the highest these two cofferdams were carried out or were purposely destroyed. At Culvert No. 6 the drainage was taken directly into the canal, the opening in the well of the flushing arrangement being planked over. The water surface in the feeder being so much below the

bed of the ditch, a bulkhead was built at the upper end of the wing walls to prevent undue erosion of the bed of the ditch and its banks. This bulkhead was destroyed purposely, a saw being used to remove the timbers. The water entering the feeder at Culvert No. 1, after the destruction of the cofferdam, flowed down the feeder and escaped from it through an opening which had been left at Culvert No. 2. No complaint of damage has been entered in regard to this increased flow down that drainage line. The increased flow from Culverts Nos. 6 and 8 flowed down the feeder to Culvert No. 9 and escaped through an opening in the bank which had been left at that point. Many complaints were entered in regard to this matter, and as soon as it could be done cofferdams were rebuilt in Culverts Nos. 6 and 8, as well as in Culvert No. 1, and the opening in the bank at Culvert No. 9 raised above the water surface. The present condition of culverts is very unsatisfactory, as the cofferdams can readily be destroyed and water directed into channels in which it would not naturally flow. The gates for closing the flushing devices should be built at the earliest date possible.

In the matter of highway bridges along the feeder, the writs of injunction of the highway commissioners were dismissed by the United States circuit court for lack of jurisdiction. In filing the decree, however, it was made to read that the cases were dismissed for lack of equity. The highway commissioners took an appeal from this to the United States court of appeals, and this court remanded the case to the United States circuit court with directions to dismiss the cases for lack of jurisdiction. No work has been undertaken in connection with the highway bridges along the feeder, work standing in practically the same condition as in September, 1900, when the injunction suits were instituted. During the year minor repairs have been made to the temporary bridges crossing the feeder and to temporary roads. Some of them are in very unsatisfactory condition, and the matter of building highway bridges over the feeder should be settled and the bridges constructed at the earliest date possible. At highway bridge No. 44, which was not covered by any of the injunctions, the splay walls, slope paving, approaches, and railings have been completed.

Late last year the construction of the masonry of the headworks of the feeder was entered upon. A new concrete mixer was purchased, necessary forming material purchased, and the masonry of the lock, sluiceways, and abutment completed. In this work the excavation of 1,160 cubic yards of rock in the foundation cost \$1,579.36, or a cost of \$1.36 per cubic yard. Natural cement concrete was deposited as a foundation for the walls, a total of 79.9 cubic yards being deposited at a cost of \$403.21, or \$5.05 per cubic yard. In the walls of the lock, the piers, and sills of the sluice gates, and the bridge abutment, a total of 2,404.7 cubic yards of Portland cement concrete were deposited at a cost of \$15,584.80, or a cost per cubic yard of \$6.48. The Portland cement concrete consisted of one part cement, four parts gravel, and five parts crushed stone, all exposed surfaces being faced with a mixture composed of one part cement to two parts sand.

No work has been done upon the movable dam to be built across Rock River further than the storing of material for the construction of masonry.

There has been no work under contract on the feeder during the fiscal year.

#### WESTERN SECTION.

The houses at Locks Nos. 25 and 28, which were under construction at the beginning of the fiscal year, were completed and are now occupied by junior engineers in charge of works in those vicinities. The telephone line from miles 49 to 62, inclusive, was built and is now in use. Work was in progress upon the foundation of Lock 23 at the beginning of the year, but the bad roads had caused a suspension of delivery of material. The foundation of this lock was completed and the plant moved to other work. Pipe Culverts Nos. 39 and 40 were completed under considerable difficulties due to high water in Green River. Culvert No. 41, west of Colona, in a very difficult position, was built during freezing weather in the winter. This culvert is of great length and no head walls have as yet been built and it is doubtful if any will be necessary. Work upon the construction of head walls and arches of Arch Culverts Nos. 35 to 38, inclusive, was commenced, but on account of the slow progress of the contractors for the foundations, but two culverts could be completed last year. Work has commenced upon the concrete masonry of Culvert No. 37 and the work is nearly finished.

Work on masonry of highway bridges, planned to be built last season, was finished under great difficulties, due to bad roads and wet weather. In addition, on account of the inability to proceed with the construction of arch culverts, the party engaged upon that work built the masonry for highway bridges Nos. 38 and 39. This leaves the masonry of but two bridges, Nos. 41 and 42, to be built on the western section,

and it is proposed to build these by the party now engaged in construction of arch culverts.

Last season was so wet that on the low ground in miles 61 and 62, practically no earthwork could be done, except in hill at west end of mile 62. A large part of the time access could not be had to work on account of water across the right of way in mile 61. During the fall and winter embankments were constructed across this slough and over Culvert No. 41, so that there could be no interruption to work by high water. Specifications were prepared and sent in for placing under contract the work of excavating miles 60 and 61, and transferring the material to form the embankments in miles 61 and 62. This work, however, was not placed under contract, and instructions given to proceed with the work with the plant on hand and by hired labor. The steam shovel, three locomotives, and sixty cars were sent to Colona, Ill., 6 miles of railway material purchased, and the work entered upon during the month of January. One cut was made through the hill during that month, but work was suspended during February on account of severe freezing weather and the necessity for repairing the steam shovel. Work was resumed in March with a single shift, and through April and May and up to June 8, with a double shift working sixteen hours per day. By the 1st of June the excavation through the first hill had been completed down to the water line, and it was necessary to go back into mile 61 and make a cut for drainage purposes. The material was found to be very soft and saturated with water. Since June 8 the work has proceeded with a single shift under great difficulty, but the cut for drainage is practically completed and work will be resumed upon the material in the hill, which is almost entirely sand. In all a total of 192,100 cubic yards were removed by the steam shovel and wasted to form embankments in miles 61 and 62. In addition 18,100 cubic yards were excavated in miles 61 and 62 by teams.

The condition of work under contracts on the western section is in a very unsatisfactory state. The earthwork on miles 29, 30, and 32, under contract with John J. McCaughey, is probably 90 per cent completed. This contract should have been completed November 30, 1902, and would readily have been completed had the season not been so wet, or had a different order of work been prosecuted. The earthwork on mile 31, under contract with Katz & Callahan, is probably 60 per cent executed, but very little work has been actually finished for estimate. Work is now under progress with two land dredges and a small force of teams, and there is little doubt but that the mile will be finished the present season, unless high water should prevent. The earthwork on mile 34 is under contract with the Pound Construction Company, and the contract time of completion is September 30, 1901. During the season of 1900 a subcontractor worked on this mile, and executed practically all of the work which gave double pay for earth moved. During the season of 1901 no work whatever was done under this contract, although the season was an extremely favorable one. During the season of 1902 a small amount of work was done, but work was suspended on account of wet weather. No work has been executed in this mile during the present season. The earthwork on mile 49, under contract with Katz & Callahan, was completed during the year, and a final estimate given August 9, 1902. The earthwork on miles 50, 51, and 52 is under contract with T. W. Kinser & Sons, the date of expiration of their contract being December 31, 1901. During the season of 1901, which was a very favorable one for that location, practically no work was done. During the year 1902 a subcontractor executed part of the west half of mile 50 and all the east half of mile 51 east of Genesee Creek. Work commenced with a small force again this season, but the force has left the work for work elsewhere. The earthwork on miles 58 and 59 is under contract with Callahan Brothers & Katz, the date of expiration of their contract being July 31, 1903. During the latter part of last season, however, these miles were practically under water all the time from floods from Green River, so that work could not be prosecuted. A good force of teams and men has recently been put upon this work. The foundations for culverts 35, 36, 37, and 38, and foundations of Locks Nos. 25 and 26 are under contract with Cogan & Pound, the expiration of the contract being November 30, 1902. Work proceeded last year with insufficient and inefficient plant, and at the end of the season the foundation of but two culverts and part of the foundation of Lock 25 had been completed. This season the foundations of culvert 37 and of Lock 25 have been completed, and work is in progress upon the foundation of culvert 38. The pit for Lock 26 has been nearly all excavated. Excavation of pits for and foundations of aqueducts Nos. 4, 5, 6 and 7 are under contract with Charles Stone, date of expiration of contract being November 30, 1902. This contractor came on the work last season, and delivered the piles and timbers for the foundations of aqueducts Nos. 4 and 5 and partially excavated the pits. Work was interrupted many times by freshets in the creeks, and finally, about the end of the year, the contractor sus-

pended operations. The materials on hand have been seized by the parties furnishing them or by other creditors and removed from the works and the pits are filling with sediment from the streams. To all appearances this contract has been abandoned.

The construction of the masonry of the four aqueducts, the foundations for which were let as a separate contract, the construction of the foundations for five locks and one aqueduct, and the construction of walls of eight locks and one highway bridge, is under contract with Page & Shnable. Under this contract 10 per cent was to have been completed during last year, 65 per cent during 1903, and the whole work completed November 30, 1904. Aside from a small amount of excavation for Lock 24, no work was under progress under this contract last season. This season the foundation for Lock 24 has been completed and the north wall and breast and miter walls for this lock completed.

An agreement was entered into with the Chicago, Rock Island and Pacific Railway Company to raise their roadbed where it crosses the canal east of Colona, to build the masonry and erect the superstructure of the bridge over the canal, and to raise the superstructure of their bridge over Green River. Some of the grading for raising their track has been done, and it is understood that the girders for the bridge are being constructed by a bridge company.

The superstructures of highway bridges Nos. 17A and 18A are under contract with Wallace Marshall, the date of expiration of contract being December 31, 1902. The contractor has delivered the steel work and erected the trusses, the work not yet being riveted. The superstructures of highway bridges Nos. 20 to 37, inclusive, except No. 36, are under contract with the Chicago Bridge and Iron Company, the date of completion of contract being December 31, 1902. This company has delivered some pine and oak lumber at the railway stations for these bridges, but none of the steel work has yet been shipped.

During the fiscal year ending June 30, 1903, Junior Engineers J. W. Woermann, F. B. Duis, John H. Best, F. C. Woermann, H. D. Harting, and C. M. Waters were transferred to work on the Illinois River. Junior Engineer B. B. Stakemiller was placed on furlough without pay, at his own request. Inspector John G. Palmer tendered his resignation to accept a position as junior engineer elsewhere. In addition to these gentlemen, I have been assisted by Junior Engineers A. O. Rowse, M. G. Barnes, Fred W. Honens, J. B. Bassett, and H. E. Reeves, and by the following persons employed in clerical capacity: W. D. Powers, Miss G. A. Deyoe, and Miss M. E. Ladd. I am indebted to all these persons for faithful performance of duties assigned them.

Very respectfully, your obedient servant,

L. L. WHEELER, *Assistant Engineer.*

Maj. J. H. WILLARD,  
*Corps of Engineers.*

#### REPORT OF MR. JAMES C. LONG, ASSISTANT ENGINEER.

PRINCETON, ILL., July 7, 1903.

MAJOR: I have the honor to submit the following report on work done under my supervision on the eastern section Illinois and Mississippi Canal during the fiscal year ending June 30, 1903.

#### MAINTENANCE.

As the larger part of the work on the eastern section of the canal has been completed, its maintenance has become a matter of importance.

On July 14, Bureau Creek, which lies adjacent to the canal from miles 2 to 16, owing to extensive rains, overflowed its banks and reached a higher stage than ever known, and in many places the water stood against the canal embankments. On mile 8, 600 feet east of Lock 7, the water ran through a muskrat den in the embankment and caused it to break, letting into the canal a volume of water almost equal to its full capacity. This swept down the canal with great velocity, undermined several splay walls at locks and bridges, caused the stone revetment to slide in many places, and made two other crevasses in the embankments on miles 2 and 4. The canal embankments are in many places honeycombed by the dens of muskrats and ground hogs, and great care must be exercised in future to prevent the creek from breaking in during freshets, also to prevent breaks in the embankment when water is turned into the canal.

## 1928 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

Repairs were made to the canal embankments where damaged and crevasses closed requiring earthwork, as follows:

	Cubic yards.		Cubic yards.
Mile 2 .....	2, 120	Mile 8 .....	2, 110
Mile 3 .....	1, 320	Mile 9 .....	370
Mile 4 .....	1, 975	Mile 10 .....	1, 093
Mile 5 .....	480	Mile 11 .....	7, 446
Mile 6 .....	163		
Mile 7 .....	475	Total .....	17, 552

Of the above earthwork on miles 10 and 11 the largest part was in strengthening embankments that threatened to give way during the freshet.

An effort has been made to protect all slopes of embankments by soiling and seeding the same and keeping the weeds mowed, so as to allow the grass to grow. The accumulation of weeds after mowing from year to year had become so great that there was danger of smothering the grass. Therefore this spring the banks were thoroughly raked, all trash removed and burned, and fresh grass seed sown on all bare spots. The banks now show a decided improvement. Weeds along the canal embankments, bridge approaches, and right of way have been kept mowed, so as to allow the grass to grow freely.

The approaches to the eleven highway bridges that are completed have been kept in repair and graveled and their floors in safe condition. A new floor was placed on the span over Bureau Creek on mile 5, and when the north approach was washed away by high water it was rebuilt and a timber crib loaded with stone placed on the upper side for protection.

Two wooden farm bridges, one over the outlet of arch culvert No. 4, on mile 7, and the other across the seep ditch on mile 5, which had been carried away by the July flood, were rebuilt.

There is now 58 miles of barbed-wire right-of-way fence which the decree of court in condemnation proceedings requires to be kept in good condition. This fence has been in use several years, and on much of it the posts have begun to rot out, which has required extensive repairs, which have been made. On mile 20 the fence has been moved back 75 feet on each side of the canal to inclose the additional right of way that has been acquired. Eleven highway bridges, three aqueducts, three superintendents' houses, and two lock-keepers' houses have been repainted and kept in repair.

There is now laid on the towpath of the canal a narrow-gauge railroad track from mile 5 to mile 20, equipped with switches, water tanks, flat and dump cars, and one locomotive. From mile 5 to mile 15 it has not been in use and is so out of repair that it is not safe for a locomotive to run over it, and can only be used by hauling cars drawn by horses over it. A question to be considered is whether it would be best to take up this part of the track before it becomes impassable even for cars drawn by horses and store the material or keep it in repair, to be used for the delivery of material in the construction of lock gates, aqueducts, and buildings. It might also be useful in repairing the canal banks, in case they should break at any time, to convey earth to be used for repairs. In the construction of the canal embankments all suitable earth convenient to the canal has been consumed and can not now be had except by hauling it a long distance, a slow and expensive process. With the present system of patrolling the banks during dangerous periods notice could be given by telephone and men and material delivered promptly at a threatened point in time to avert extensive damage.

The telephone line was hastily constructed in 1896 by stringing the wires on 2 by 4 inch pine scantling nailed to posts of the right of way fence. These supports have become rotten and not suitable for the purpose. The line is now being repaired and wire suspended on cedar posts along the towpath, where it can be easily cared for and where it is not liable to come in contact with trees, etc.

On the land of Nelson Erickson, adjoining the canal near the west end of mile 8, the drainage has been obstructed, causing water, during heavy rains, to stand on 10 acres of said land. This is due to the seep ditch becoming filled by debris from a small stream intercepting it at right angle. This is being remedied by excavating the seep ditch, laying a 12-inch sewer pipe in the bottom to carry the drainage under the obstructed point; also by changing the course of the intercepting stream that filled the seep ditch with debris, so as to discharge into the double 48-inch pipe culvert near mile 8.7.

### CONSTRUCTION WORK.

*Mile 18.*—Highway bridge No. 11 has been completed, except laying the floor. The work done is as follows:

Superstructure: Steel highway bridge, crossing the canal at an angle of 52° 30'

with its axis, 128 feet 7 inches long and centers 19 feet 3 inches wide center to center of trusses, with 18 feet clearance at portals.

Abutments: Founded on piles; containing 670 cubic yards of natural cement concrete, and 362 cubic yards of Portland cement concrete.

Approaches: Containing 20,650 cubic yards of earthwork.

The superstructure was erected under contract with Wallace Marshall. The abutments and approaches were constructed by hired labor.

*Mile 19.*—Work accomplished during the year: 1,690 cubic yards earthwork, 333 linear feet pile and sheet pile revetment, 195 square yards slope paving.

At the western end of this mile and the eastern end of mile 20 a portion of the canal prism is excavated through a stratum of quicksand lying near the canal bottom, which caused the slopes to be unstable. To protect the slopes a line of pile and Wakefield sheet pile revetment was driven where necessary. On the towpath side slope paving has been laid on top of the sheet piling to protect the towpath on which the narrow-gauge railroad track has been laid. In places the material was so unstable that it would not stand sufficiently to make the towpath and bed for the railroad track. This was overcome by laying small tile at one side of the towpath at foot of slope of excavation, collecting the water with which the soil was saturated, and discharging it at 100-foot intervals into the canal. This method has proved very satisfactory and a stable towpath and roadbed has been obtained.

*Mile 20.*—Work accomplished during the year: 19,207 cubic yards earthwork, 1,382 linear feet pile and sheet pile revetment, 672 square yards slope paving, 3 8-inch sewer pipe intakes, 1 36-inch cast-iron pipe intake, 1 18-inch sewer pipe laid under waste banks to drain adjoining land.

The western half of this mile is situated in the peat swamp known as Cecil's slough, which extends to the middle of mile 22. Nothing has been done toward the excavation of the canal trunk through this peat swamp except to begin making a ditch which will extend through its entire length to drain off the water preparatory to beginning work with traveling cableway excavators, plans and estimates for which have already been submitted.

*Mile 22.*—Nothing has yet been done toward excavating in canal trunk on this mile. The abutments of highway bridge No. 14 have been completed. They are founded on piles driven to a firm bearing with a 3,000-pound hammer. The piles under the south abutment were cut 25 feet long, but were found to be too short and were spliced with 11-foot piles; those under the north abutment were 20 feet long. This bridge crosses the canal in the peat bog known as Cecil's slough, and as the piles were cut off 12 feet below the surface of ground it was necessary to drive sheet piling around the foundation pits. In the north pit considerable trouble was experienced by springs spouting quicksand, but the difficulty was overcome by the use of bags of sand and bags of dry concrete. All of the round piles used in the foundation were driven with a 12-foot follower before the pits were excavated, because the nature of the material would not permit of placing a pile driver in the pit. The amount of concrete masonry in the abutments is as follows:

	Cubic yards.
Portland cement concrete .....	312
Natural cement concrete .....	54

*Mile 23.*—The location of the canal on this mile is in a small valley locally known as Hornby's slough, the drainage of which necessitated the construction of a ditch along the center line 4,500 feet in length. The ditch is 3 feet wide in the bottom and of an average depth of 4 feet, requiring 4,500 cubic yards of excavation. No excavation in canal trunk has been done except 500 cubic yards to obtain the earth placed in bridge approaches.

The abutments of highway bridge No. 15 were completed. These are founded on piles 20 feet long driven to a firm bearing with a 3,000-pound hammer, and contain concrete masonry as follows:

	Cubic yards.
Portland cement concrete .....	248
Natural cement concrete .....	107

*Mile 24.*—The earthwork on this mile was 96 per cent complete at the beginning of the year, the remainder being bank construction with earth taken from a pit five-eighths of a mile distant and hauled to the site in cars by our narrow-gauge railroad. This work was mostly finishing work, and this, in connection with the very wet weather of last summer, made the work expensive. Another cause of expense was the settlement of the banks due to the compression of the peat foundation on which they rested, thereby greatly increasing the amount of track work necessary for the construction. The earthwork is now complete except about 2,000 cubic yards of peat

yet to be removed from the bottom of a section where it was forced up by the weight of the embankments. The earthwork done on this mile during the year was 13,996 cubic yards of embankment.

*Mile 25.*—Earthwork on this mile was 95 per cent complete, and only 9,000 cubic yards of excavation and embankment remained to be done, but it could not be completed until the banks on mile 24 were finished, and it has been too wet for work ever since. Four thousand five hundred cubic yards of earthwork was executed during the year, is now 77 per cent complete, and will be finished during the month of July.

*Miles 26, 27, and 28.*—No work remains to be done on these miles except to remove the temporary highways around highway bridges 16, 17, and 18 and complete the splay walls, which will be done as soon as these bridges are complete.

Highway bridges 16, 17, and 18 are under contract with Wallace Marshall, of Lafayette, Ind., and they have been erected with bolts, but have not yet been riveted and floored.

The work done during the first half of the fiscal year was executed for the most part under very trying conditions. The season was unusually wet, making earthwork, which was all in low and badly drained ground, slow and expensive. Much of it had to be suspended until a dry time comes later on. There has also been a great scarcity of teams and labor, which has greatly hindered the work. I would recommend that the machinery estimated for to do the work on miles 20.6 to 23 be purchased as soon as possible, for then the work can be pushed forward independent of laborers and teams, and the excavation can proceed regardless of wet weather.

The following brands of cement were used on the work after being submitted to the usual tests: "Sailors" and "Atlas" Portland cements, "Utica" natural cement.

Special tests were also made of the following Portland cements: "Chicago AA," "Sandusky," and "Marquette."

In conclusion I desire to thank the following gentlemen for faithful and intelligent attention to duty: Junior Engineers J. D. Truss, S. L. Bayless, and Joseph Wright, Clerk C. F. Scott, and Inspector George W. Choate.

Very respectfully, your obedient servant,

JAS. C. LONG,  
*Assistant Engineer.*

Maj. J. H. WILLARD,  
*Corps of Engineers.*



## APPENDIX O O.

---

### IMPROVEMENT OF MICHIGAN CITY HARBOR, INDIANA, AND OF RIVERS AND HARBORS ON THE EASTERN SHORE OF LAKE MICH- IGAN.

---

REPORT FOR THE FISCAL YEAR ENDING JUNE 30, 1903. WITH OTHER  
DOCUMENTS RELATING TO THE WORKS. OFFICERS IN CHARGE,  
CAPT. CHARLES KELLER, MAJ. J. G. WARREN, AND LIEUT. COL.  
M. B. ADAMS, CORPS OF ENGINEERS.

#### IMPROVEMENTS.

- |  |  |
|--|--|
| 1. Harbor at Michigan City, Indiana.                     | 8. Muskegon Harbor, Michigan.                        |
| 2. St. Joseph Harbor and River, Michi-<br>gan.           | 9. Harbors at Pentwater and White<br>Lake, Michigan. |
| 3. Harbor at South Haven, Michigan.                      | 10. Harbor at Ludington, Michigan.                   |
| 4. Harbor at Saugatuck and Kalamazoo<br>River, Michigan. | 11. Harbor at Manistee, Michigan.                    |
| 5. Harbor at Holland (Black Lake),<br>Michigan.          | 12. Harbor of refuge, at Portage Lake,<br>Michigan.  |
| 6. Harbor at Grand Haven, Michigan.                      | 13. Frankfort Harbor, Michigan.                      |
| 7. Grand River, Michigan.                                | 14. Harbor at Charlevoix, Michigan.                  |
|  | 15. Harbor at Petoskey, Michigan.                    |
- 

UNITED STATES ENGINEER OFFICE,  
*Grand Rapids, Mich., July 18, 1903.*

GENERAL: I have the honor to submit herewith the annual report  
of works of river and harbor improvement under my charge for the  
fiscal year ending June 30, 1903.

Very respectfully, your obedient servant,

M. B. ADAMS,  
*Lieut. Col., Corps of Engineers.*

Brig. Gen. G. I. GILLESPIE,  
*Chief of Engineers, U. S. A.*

---

## O O I.

### IMPROVEMENT OF HARBOR AT MICHIGAN CITY, INDIANA.

The history of this improvement is brought to the beginning of the  
fiscal year in the Report of the Chief of Engineers for 1902, pages  
2137-2139.

#### OPERATIONS DURING FISCAL YEAR ENDING JUNE 30, 1903.

The property stored at this harbor has been cared for by the watch-  
man who is employed for this purpose, and who also maintains the

pier lights. The Light-House Establishment has thus far made no provision for lighting the harbor structures, but has loaned four lens lanterns, which are maintained at the expense of the appropriation for this harbor.

Work under the continuing contract of Stebbings & Wenzell for the extension of the breakwater pier and the construction of the new detached breakwater has been continued. The pile foundation of crib 6 for the extension of the breakwater pier was completed and the crib sunk in its place on July 11, 1902. The superstructure, 8 feet high, was completed, the space between the projecting horns at the outer end was filled with a guard structure of vertical and horizontal timbers, mooring posts at distances of 50 feet between each other were built into the work, the structure was filled with stone and decked over, and the lake face for a length of 200 feet from the outer end and the end were riprapped with heavy stone. This completed the part of the contract relating to the extension of the breakwater pier, which latter now has a total length of 1,136.7 feet. The construction of the new detached breakwater progressed better than in the previous year. The stone foundation of the first ten cribs, commencing at the northerly end, was completed and leveled, and these cribs were sunk in their positions, Nos. 1 to 6, during the period from July to November, 1902, Nos. 7 and 8 in May, 1903, and Nos. 9 and 10 in June, 1903. All the cribs are riprapped with heavy stones on the lake side. Cribs 1 to 6 were provided with a temporary deck, but during the winter storms this deck was almost entirely torn off and the stone filling was washed out to an average depth of approximately 3 feet.

No attempt has been made this spring to replace the temporary deck, but the contractor has covered the filling in all the pockets with large stones, 1 to 2 tons weight, in the expectation that they will protect the work against further loss of ballast. In addition to the cribs already sunk, the construction of the remaining three has been nearly completed. All the cribs are 100 feet long, 30 feet wide, and Nos. 1 to 6 are 24½ feet high, and the remainder 22½ feet. The theoretical level of the top of the cribs is 2 feet above the zero of the harbor gauge, and where the cribs have settled below this level they must be shimmed up before work on the superstructure is begun. At the end of the year this leveling-up operation had been completed for cribs 1 and 2, and the two first courses of the superstructure had been built for lengths of 195 and 187 feet.

The removal of the old detached breakwater has been completed for a length of 250 feet at the easterly end, and a large part of the superstructure of the remainder has been removed. The stone removed from this work has been utilized in the construction of the new work, and part of the old timber, which was found still serviceable, was used in the interior walls of the submerged portions of the new cribs. Owing to the greatly increased requirement of stone for the foundation of the new work and the additional cost of leveling up the cribs, the construction of 14 cribs for the detached breakwater, as provided for by the existing contract, appeared to be impracticable with the available funds, and a supplementary contract was therefore entered into under date of February 27 to reduce the number of cribs to 13.

A contract was entered into on February 27, 1903, with Robert Millen & Co. for repairing the west entrance pier from station 16+20 to 21+58, the east entrance pier from station 6+70 to 14+05, and for closing the entrance to the outer basin. The repairs will consist in cutting the old work down to the level of zero of gauge, reen-

forcing the front wall of the submerged work by a system of sheet piles and round piles, and building a new superstructure. The structure to close the entrance to the outer basin will be a sheet-pile work backed with stone and surmounted by a timber superstructure. As part of the old east pier has a width of 25 feet and more, it was planned to reduce this width by driving a row of rear piles through the submerged old work. The practicability of doing this was satisfactorily established before advertising for bids, by driving successfully ten test piles, provided with iron shoes and of the required length, on the proposed line by day labor. Operations under this contract were begun April 21, but progress has been slow owing to delays in receiving an adequate supply of timber and planks of the specified quality. These delays are not believed to be due to dilatoriness on the part of the contractors, who appear to have done everything possible to get the material, and it may be said that the same difficulties are encountered by the contractors at the other harbors.

The work done to the end of the fiscal year was as follows: In the west pier, between stations 16+20 to 21+58, the old superstructure was removed and the piles of the old side and end rows were sawed off at grade. The old front piles were capped between stations 16+15 and 21+58, the old rear piles between stations 21+09 and 21+58, as also the piles in the end wall. The first course of the new superstructure in the rear wall was put in place from station 16+17.5 to 17+34.3, and the guide for the front sheet piles from station 18+01.2 to 21+58.6. In the east pier, station 6+70 to 14+05, the old superstructure was removed between stations 8+20 and 12+88 in the front wall and between stations 7+76 and 12+88 in the rear wall; the substructure was repaired between stations 7+85 and 11+28 in the rear wall, 16 new piles were driven in the rear row between stations 13+29 and 13+89.5, and the first course of the new superstructure in the rear wall was secured between stations 7+80.5 and 9+80.8. For the pile pier to close the entrance to the outer basin, 117 round piles were driven in the rear row between stations 14+05.5 and 18+70, 106 round piles in the front row between stations 14+53.5 and 18+41, and 1 at station 18+69.5, and 2 compound sheet piles were put in place at stations 18+72 to 18+70.

#### CONDITION OF WORK JUNE 30, 1903.

The west entrance pier, as built by the Government, has a total length of 2,158 feet, consisting of 1,358 feet of pile work and 800 feet of crib work. The inner section of 785 feet was formerly occupied by private parties, but at the present no such use is made of it. The inner end for a length of 228 feet is destroyed, the next 386 feet has been rebuilt during recent years by the riparian owners. The outer part of the west pier for a length of 538 feet is now under contract to be repaired and sheet piled. The remainder, 1,006 feet in length, is in need of extensive repairs above water by sheet piling to make it sand-tight. The east entrance pier has a total length of 1,405 feet, of which the inner 670 feet is in front of private property and totally wrecked. The outer section, 735 feet long, is now under contract to be substantially repaired and sheet piled. A city ordinance requires riparian owners to maintain docks or revetments along their water fronts in the inner harbor, but the existing revetments are in bad condition in many places.

## 1934 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

The breakwater pier, separated from the outer end of the east entrance pier by the opening to the outer basin, which is about 467 feet wide, was extended 100 feet during the last fiscal year, and has now a total length of 1,136 feet. It is in good condition. The opening to the outer basin is being closed by a sheet-pile structure, of which the round piles of the two side walls have nearly all been driven. The closing of the basin renders the further maintenance of the old east breakwater and the pile pier inclosing the basin on the east unnecessary, and these structures are to be abandoned. The stone foundation of the new detached breakwater has been practically completed for a length of 1,300 feet, and 10 cribs, each 100 feet long and 30 feet wide, are now in place. Two hundred and fifty feet of the old detached breakwater at its easterly end have been satisfactorily removed. It is probable that additional riprap will be required on the exposed sides of the breakwater pier and of the new detached breakwater to render these structures secure.

The condition of navigation, as shown by soundings of May 13-16, is as follows, the depths being referred to the level of zero of gauge: Twenty and five-tenths feet opposite the present end of the breakwater pier; 18 feet at the entrance to the inner harbor opposite the end of the west pier; 15.2 feet between the piers; 15.2 feet from inner end of piers to angle below the Michigan Central Railroad Bridge; 14.7 feet in north draw of Second Street Bridge; thence 14.4 feet to the first angle above the Sixth Street Bridge; thence 13 feet to the second angle, and 10.4 feet near the lower end of the upper basin. The stage of the lake at time of survey was 0.9 to 1.4 feet below zero of gauge.

### WORK PROPOSED FOR FISCAL YEAR ENDING JUNE 30, 1904.

The work under the contract with Stebbings & Wenzell for the construction of the detached breakwater, and that under the contract with Robert Millen & Co. for the repairs of piers and closing entrance to outer basin will be completed. Of the balance remaining available it is proposed to expend about \$2,500 for dredging during the current year under the contract with the Lydon & Drews Company, to reserve \$4,100 as part payment for an inspection steamer and the remainder for the payment of office expenses and contingencies and for such additional dredging, repairs, and riprapping the outer harbor structures as may become necessary.

### ESTIMATE OF FUNDS FOR FISCAL YEAR ENDING JUNE 30, 1905.

Upon the completion of the present contract for the construction of the new detached breakwater there will remain 200 linear feet still to be added to that structure to complete the approved project. The estimated cost of this work is \$30,000.<sup>a</sup> After the completion of the repairs of the outer 538 feet of the west entrance pier there remains an additional length of 1,006 feet, which must be maintained by the Government and which is in need of sheet piling and new superstructure. This, estimated at \$27.50 per linear foot, will cost \$27,665. The estimate for dredging is the same as that in the last annual report, viz, \$20,000. The total estimate is therefore as follows:

---

<sup>a</sup>As this constituted an increased estimate for the completion of the approved project, an estimate was submitted to the Chief of Engineers by letter dated July 9, 1903, in compliance with instructions contained in General Orders, No. 5, current series.

# APPENDIX O O—REPORT OF LIEUT. COL. M. B. ADAMS. 1935

For construction.....	\$30,000
For maintenance:	
Repairs.....	\$27,665
Dredging.....	20,000
	<u>47,665</u>
Total.....	77,665
Total amount appropriated and allotted to June 30, 1903.....	\$1,539,138.92
Miscellaneous receipts.....	4,190.00
	<u>1,543,268.92</u>
Less amount carried to surplus fund.....	5.15
	<u>1,543,263.77</u>
Total amount expended on previous projects from July 4, 1836, to June 30, 1902:	
For construction.....	\$1,009,507.04
For maintenance.....	187,084.80
	<u>1,196,591.84</u>
Total amount expended to June 30, 1903, on existing project adopted March 3, 1899, for construction.....	176,767.14
Balance.....	<u>169,904.79</u>
Estimated cost of existing revised project.	

## *Money statement.*

July 1, 1902, balance unexpended.....	\$272,197.89
Miscellaneous receipts.....	4,100.00
	<u>276,297.89</u>
June 30, 1903, amount expended during fiscal year.....	106,398.10
July 1, 1903, balance unexpended.....	169,904.79
July 1, 1903, outstanding liabilities.....	318.44
	<u>169,586.35</u>
July 1, 1903, balance available.....	144,545.74
July 1, 1903, amount covered by uncompleted contracts.....	<u>30,000.00</u>
Amount (estimated) required for completion of existing project.....	30,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1905, in addition to the balance unexpended July 1, 1903:	
For works of improvement.....	\$30,000.00
For maintenance of improvement.....	47,665.00
	<u>77,665.00</u>
Submitted in compliance with requirements of sundry civil act of June 4, 1897, and of section 7 of the river and harbor act of 1890.	

## APPROPRIATIONS.

Date.	Outer harbor.	Inner harbor.	Total.
July 4, 1836.....			\$20,000.00
March 3, 1837.....			30,000.00
July 7, 1838.....			60,733.59
June 11, 1844.....			25,000.00
August 30, 1852 <sup>a</sup> .....			20,000.00
March 2, 1855 (claim of J. E. Bowes).....			470.38
June 23, 1855.....			75,000.00
July 25, 1868 (allotment).....			25,000.00
April 10, 1869 (allotment).....			31,185.00
July 11, 1870.....	\$25,000.00		25,000.00
March 3, 1871.....	15,000.00		15,000.00

<sup>a</sup> Amount carried to surplus fund, \$5.15

# 1936 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

## APPROPRIATIONS—continued.

Date.	Outer harbor.	Inner harbor.	Total.
June 10, 1872 .....	\$50,000.00		\$50,000.00
March 3, 1873 .....	50,000.00		50,000.00
June 23, 1874 .....	50,000.00		50,000.00
March 3, 1875 .....	50,000.00		50,000.00
August 14, 1876 .....	35,000.00		35,000.00
June 18, 1878 .....	50,000.00	\$25,000.00	75,000.00
1878 (allotment) .....	2,500.00		2,500.00
March 3, 1879 .....	40,000.00		40,000.00
June 14, 1880 .....	40,000.00	15,000.00	55,000.00
March 3, 1881 .....	20,000.00	25,000.00	45,000.00
August 2, 1882 .....	60,000.00	20,000.00	80,000.00
July 5, 1884 .....	40,000.00	10,000.00	50,000.00
August 5, 1886 .....	54,375.00	1,875.00	56,250.00
August 11, 1888 .....	90,000.00	5,000.00	95,000.00
September 19, 1890 .....	50,000.00	7,500.00	57,500.00
July 13, 1892 .....	30,000.00	15,000.00	45,000.00
August 18, 1894 .....	20,000.00	10,000.00	30,000.00
June 3, 1896 .....	70,000.00	10,000.00	80,000.00
March 3, 1899 .....		7,500.00	7,500.00
June 6, 1900 .....	195,000.00		195,000.00
June 13, 1902 .....			63,000.00
Miscellaneous receipts .....			4,130.00
Total .....	1,038,875.00	151,875.00	1,543,298.92

## ABSTRACT OF CONTRACTS IN FORCE.

### *Construction of breakwaters.*

Contractor: Stebbings & Wenzell.

Date of contract: February 3, 1900.

Date of approval: February 21, 1900.

Date of beginning: May 1, 1900.

Date of expiration: June 30, 1901; changed to December 31, 1901, by supplemental contract dated August 24, 1901; time limit waived. Supplemental contract dated July 19, 1901, provides for use of pine timber in place of hemlock, if desired; supplemental contract dated January 19, 1903, provides for use of Douglas fir or long leaf yellow pine timber in place of white pine in five lower courses of superstructure and for long leaf yellow pine in uppermost course of side and end walls of superstructure; supplemental contract dated March 24, 1903, provides for 13 cribs in detached breakwater instead of 14 as originally agreed.

Rates: Dredging, \$1 per cubic yard; foundation piles, 30 cents per linear foot; white oak timber, \$50 per M feet B. M.; white pine timber, \$30.80 per M feet B. M.; hemlock timber, \$24 per M feet B. M.; white pine decking, \$25 per M feet B. M.; driftbolts, screw bolts, and spikes, 4 cents per pound; stone, \$7.50 per cord.

### *Repair of piers and closing entrance to outer basin.*

Contractor: Robert Millen & Co.

Date of contract: February 27, 1903.

Date of approval: March 21, 1903.

Date of beginning: April 15, 1903.

Date of expiration: January 1, 1904.

Rates: Cutting down and removing old work, \$3 per linear foot; white oak piles, 33 cents per linear foot; white-oak timber, \$40 per M feet B. M.; white pine, long leaf yellow pine or Douglas fir timber, \$33 per M feet B. M.; white pine, long leaf yellow pine, or Douglas fir planks for sheet piles, \$39 per M feet B. M.; white pine or long leaf yellow pine for decking, \$30 per M feet B. M.; driftbolts, 2½ cents per pound; screw bolts and tie-rods, 3 cents per pound; carriage bolts and spikes, 4 cents per pound; stone, \$6.50 per cord.

### *Dredging.*

Contractor: The Lydon & Drews Company.

Date of contract: March 26, 1903.

Date of approval: May 6, 1903.

Date of beginning: May 24, 1903.

Date of expiration: October 9, 1903.

Rate: 16½ cents per cubic yard.

# APPENDIX O O—REPORT OF LIEUT. COL. M. B. ADAMS. 1937

## COMMERCIAL STATISTICS FOR CALENDAR YEAR ENDING DECEMBER 31, 1902.

[Compiled from statement furnished by Mr. James Wooden, United States watchman at Michigan City, Ind.]

Character of vessels.	Number.	Tonnage.
Steam .....	826	290,431
Sail .....	51	8,986
Total .....	877	299,416

Maximum draft 15.3 feet in inner harbor to lower basin, and 11.1 feet above.

### Receipts and shipments by vessel, 1902.

Articles received.	Tons.	Articles shipped.	Tons.
Lumber .....	131,250	Coal .....	131
Laths .....	800	Brick .....	200
Shingles .....	1,100		
Ties .....	5,000		
Salt .....	750		
Wood .....	211		
Fruit and vegetables .....	173		
Total .....	138,784	Total .....	331

NOTE.—No record is kept of traffic between Michigan City and Chicago.

Total freight carried in 1901 .....	Tons. 111,949
Total freight carried in 1902 .....	139,115
Increase .....	27,166

## O O 2.

### IMPROVEMENT OF ST. JOSEPH HARBOR AND RIVER, MICHIGAN.

The history of these works to the beginning of the year is found in the Report of the Chief of Engineers for 1902, pages 2141-2143, and in the Report of the Chief of Engineers for 1901, page 3083.

#### (a) ST. JOSEPH HARBOR—OPERATIONS DURING FISCAL YEAR ENDING JUNE 30, 1903.

The Lydon & Drews Company, contractors for the extension of the piers, continued operations, and although the work has not yet been completed, it is now so far advanced that its final completion during the present working season may be regarded as certain. The seven remaining cribs for the north pier extension were sunk in their proper position between July 28 and October 3, and the timber work of the six-course superstructure, together with the guard structure, consisting of piles and horizontal timbers screw-bolted to the outer end wall, were completed before the close of the season of 1902. The pier was provided with mooring posts, 50 feet apart. Only a small amount of stone filling and the deck for a length of 390 feet remain to be placed for the final completion of this part of the contract. In the south pier three cribs were sunk in their places during the working season

1938 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

of 1902, and the four remaining ones during May and June, 1903. All the cribs sunk during this fiscal year are 100 feet long, 30 feet wide, and 18½ feet high, and each rests on a foundation of 84 piles, distributed in four parallel rows under the longitudinal walls. Each of the six courses of superstructure over the south pier cribs was extended 600 feet. A considerable amount of stone filling has been placed in the superstructure, and the 13 guard piles for the protection of the outer end of the piers were driven.

Under date of May 18 a contract was entered into with the Chicago and Great Lakes Dredge and Dock Company for repairing the north pier between stations 0 and 4+54 E., and for refilling the north pier between stations 8+20 and 15 and the south pier between stations 0 and 8+20. Operations under this contract were begun during June, but nothing except the removal of part of the old superstructure in the north pier had been accomplished at the end of the fiscal year.

CONDITION OF WORK JUNE 30, 1903.

The total length of the north pier and revetment is 2,854 feet, consisting of 2,183.5 feet crib work and 670.5 feet pile work. At the east end a pile wing 165 feet long connects with the dock of the United States light-house depot. The south pier is about 2,620 feet long and consists of 1,800 feet crib work and 820 feet pile work. Upon the completion of the contracts now in force all these structures will be in excellent condition except the wing at the east end of the north pier, the filling of which is not in good condition.

Upon the opening of navigation early in March a bar with only 3 feet of water in the middle of the channel was found to exist in the Benton Harbor Canal at the mouth of the Paw Paw River. The steamer *Soo City*, of the Graham & Morton Transportation Company, removed this obstruction by scouring a channel through it with a central depth of 14 feet referred to the stage of zero of gauge.

Soundings made April 18-23, 1903, showed the following available depths: Twenty-two feet outside of the entrance, 17.3 feet on the shoal between the ends of the piers, 17 feet on the best course between the piers, 15 feet above the railroad bridge, and 14.5 feet in the Benton Harbor Canal. These depths refer to the zero of the gauge, which is 581.28 feet above mean tide at New York. The stage of the lake at time of survey was 1 to 1.3 feet below zero of gauge.

(b) ST. JOSEPH RIVER.

No work was done during the past fiscal year, as the depth of channel was sufficient for the requirements of vessels navigating the river.

The Indiana, Illinois and Iowa Railroad Company dredged the channel through its new bridge and immediately above and below to a depth of 6 feet below low water.

WORK PROPOSED FOR FISCAL YEAR ENDING JUNE 30, 1904.

The work under the contract with the Lydon & Drews Company for the extension of the piers, and under the contract with the Chicago and Great Lakes Dredge and Dock Company for the repairs of the piers will be completed. Of the balance remaining available for St. Joseph Harbor, it is proposed to allot \$10,000 as part payment of the new hydraulic dredge, \$1,500 as part payment of an inspection



steamer, and about \$5,000 for dredging during the present season under the contract with the Lydon & Drews Company. The balance to be reserved for contingencies and such additional dredging and incidental repairs as may become necessary. With the funds available for St. Joseph River it is proposed to do such work as may be needed to restore the 3-foot channel of the approved project.

#### ESTIMATE OF FUNDS FOR FISCAL YEAR ENDING JUNE 30, 1905.

With the conclusion of the contracts now in force all new construction work under the authorized project will have been completed and the existing structures on the entrance channel will be in serviceable condition. The soundings of April 18-23, 1903, show that the interior channels have considerably deteriorated since the general dredging of 1901. The accretions of sand causing this deterioration are brought down by the St. Joseph and Paw Paw rivers, when in flood, and as this is a matter of annual recurrence, it follows that dredging for the restoration of the required widths and depths of channel may be expected to be necessary every year. The amount estimated required for this purpose and for incidental repairs for one year is \$10,000, or for two years, \$20,000. The estimate for St. Joseph River is \$750. The total amount of the estimate is therefore \$20,750.

#### *St. Joseph Harbor and River.*

Total amount appropriated and allotted to June 30, 1903 .....	\$864,563.00
Miscellaneous receipts .....	1,027.15
	<hr/>
	865,590.15
Less amount carried to surplus fund .....	.80
	<hr/>
	865,589.35
Total amount expended July 4, 1836, to March 3, 1899:	
For construction .....	\$341,084.99
For maintenance .....	167,578.24
	<hr/>
	508,613.23
Total amount expended on project approved March 3, 1899:	
For construction .....	241,560.81
For maintenance .....	17,638.70
	<hr/>
	259,199.51
Balance .....	<hr/>
	97,776.61
Estimated cost of revised project approved March 3, 1899, \$358,000.	

#### *Money statement.*

July 1, 1902, balance unexpended .....	<sup>a</sup> \$237,295.25
Miscellaneous receipts .....	500.00
	<hr/>
	237,795.25
June 30, 1903, amount expended during fiscal year .....	140,018.64
	<hr/>
July 1, 1903, balance unexpended .....	97,776.61
July 1, 1903, outstanding liabilities .....	808.33
	<hr/>
July 1, 1903, balance available .....	97,468.28
July 1, 1903, amount covered by uncompleted contracts .....	74,215.94
	<hr/>
{ Amount that can be profitably expended in fiscal year ending June 30, 1905, for maintenance of improvement, in addition to the balance unexpended July 1, 1903 .....	20,750.00
{ Submitted in compliance with requirements of sundry civil act of June 4, 1897, and of section 7 of the river and harbor act of 1899.	

<sup>a</sup> Increased \$47.20. Deposit August 5, 1893, by Maj. William Ludlow, not hitherto taken up.

# 1940 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

## APPROPRIATIONS.

### *St. Joseph Harbor and River, Michigan.*

July 4, 1836 .....	\$20,000.00	June 18, 1878 .....	\$12,000.00
March 3, 1837 .....	15,000.00	March 3, 1879 .....	6,000.00
July 7, 1838 .....	51,113.00	June 14, 1880 .....	8,000.00
March 3, 1843 .....	25,000.00	March 3, 1881 .....	10,000.00
June 11, 1844 .....	20,000.00	August 2, 1882 .....	12,000.00
August 30, 1852 .....	10,000.00	July 5, 1884 .....	15,000.00
June 28, 1864 (allotment) .....	15,000.00	August 5, 1886 .....	10,000.00
June 23, 1866 .....	6,000.00	August 11, 1888 .....	12,000.00
March 2, 1867 .....	23,000.00	September 19, 1890 .....	20,000.00
Allotted from har-		July 13, 1892 .....	59,000.00
bors on North-		August 18, 1894 .....	30,000.00
western Lakes,		June 3, 1896 .....	30,000.00
1867 .....	\$7,500.00	March 3, 1899 .....	50,000.00
Transferred in		June 6, 1900 .....	253,950.00
1870 to Grand		March 3, 1901 .....	38,000.00
Haven Harbor .....	500.00	June 13, 1902 .....	24,000.00
		Miscellaneous receipts .....	1,027.15
	7,000.00		
July 11, 1870 .....	15,000.00	Total .....	860,090.15
March 3, 1871 .....	10,000.00	Amount carried to surplus	
June 10, 1872 .....	3,000.00	fund, 1856 .....	.80
June 23, 1874 .....	2,000.00		
March 3, 1875 .....	35,000.00	Balance .....	860,089.35
August 14, 1876 .....	12,000.00		

### *St. Joseph River, Michigan.*

August 11, 1888 .....	\$2,500
September 19, 1890 .....	1,000
July 13, 1892 (allotment) .....	1,000
August 18, 1894 .....	500
June 3, 1896 .....	500
Total .....	5,500

## ABSTRACT OF CONTRACTS IN FORCE.

### *Dredging.*

Contractor: The Lydon & Drews Company.  
Date of contract: March 26, 1903.  
Date of approval: May 6, 1903.  
Date of beginning: May 24, 1903.  
Date of expiration: October 9, 1903.  
Rate: 16½ cents per cubic yard.

### *Pier extension.*

Contractor: The Lydon & Drews Company.  
Date of contract: January 12, 1900.  
Date of approval: February 5, 1900.  
Date of beginning: May 1, 1900.  
Date of expiration: June 30, 1901; changed to December 31, 1901, by supplemental contract dated September 18, 1901; time limit waived. Supplemental contract dated January 19, 1903, provides for use of Douglas fir or long-leaf yellow pine timber in five lower courses of superstructure and for long-leaf yellow pine in the uppermost course of side and end walls of superstructure and in decking.  
Rates: Dredging, 25 cents per cubic yard; foundation piles, 25 cents per linear foot; white oak guard piles, 25 cents per linear foot; white oak timber, \$50 per M feet B. M.; white pine timber, \$31.20 per M feet B. M.; hemlock timber, \$24.50 per M feet B. M.; white pine plank, \$27.60 per M feet B. M.; driftbolts, screw bolts, and spikes, 4 cents per pound; stone, \$6 per cord.

# APPENDIX O O—REPORT OF LIEUT. COL. M. B. ADAMS. 1941

## Repair of piers.

Contractor: Chicago and Great Lakes Dredge and Dock Company.

Date of contract: May 18, 1903.

Date of approval: June 4, 1903.

Date of beginning: June 1, 1904, or earlier, at option of contractor.

Date of expiration: November 1, 1904, or within five working months if begun prior to June 1, 1904.

Rates: Cutting down and removing old work, \$1.50 per linear foot; white pine, long-leaf yellow pine, or Douglas fir timber, \$34 per M feet B. M.; white pine or long-leaf yellow pine plank for decking, \$33 per M feet B. M.; driftbolts, screw bolts, and spikes, 4 cents per pound; stone, \$7.50 per cord.

## COMMERCIAL STATISTICS FOR CALENDAR YEAR ENDING DECEMBER 31, 1902.

[Compiled from statements furnished by the deputy collectors of customs at St. Joseph and Benton Harbor, Michigan.]

### ST. JOSEPH HARBOR.

Character of vessels.	Number.	Tonnage.
Steam .....	1,000	821,529
Sail .....	45	4,641
Total .....	1,705	826,170

Maximum draft, 16 feet.

### Receipts and shipments by vessel, 1902.

Articles received.	Tons.	Articles shipped.	Tons.
Lumber .....	45,000	Fruit .....	33,000
Laths .....	120	Vinegar .....	100
Shingles .....	1,522	Iron .....	12
Salt .....	2,477	Lumber .....	43
Stone .....	41,542	Pickles .....	25
Wood, slabs, etc. ....	897	Sugar .....	125
Flour .....	1,300	Canned goods .....	30
Vinegar .....	60	Paper .....	242
Coal .....	160	Hides .....	20
Paper .....	2,200	Ties .....	500
Iron .....	20	Coal .....	75
Merchandise, miscellaneous .....	30,000	Merchandise, miscellaneous .....	29,000
Total .....	125,368	Total .....	63,177

Total freight carried in 1902 .....	Tons.
Total freight carried in 1901 .....	188,545
Increase .....	121,819
	66,726

### ST. JOSEPH RIVER.

[Compiled from statement furnished by Mr. E. A. Graham, St Joseph, Mich.]

The steamers *May Graham* and *Tourist* carried 31,000 passengers and 2,731 tons of freight (principally fruit, etc.), as compared with 28,000 passengers and 2,483 tons freight carried in 1901. The boats have a maximum draft of about 3 feet.

O O 3.

IMPROVEMENT OF SOUTH HAVEN HARBOR, MICHIGAN.

The history of this work is carried to the beginning of the year in the Report of the Chief of Engineers for 1902, pages 2146 and 2147.

OPERATIONS DURING FISCAL YEAR ENDING JUNE 30, 1903.

Soundings made April 1-8, 1903, showed the following available depths, referred to the level of zero of gauge which is 581.28 feet above mean tide at New York: On outer bar, 13.4 to 14.6 feet; on shoalest section between piers, 300 feet from outer end, 12 to 13 feet; in the river above the Government revetments, 12.4 feet. The stage of the lake at time of soundings was 0.8 to 1.8 feet below zero of gauge.

Dredging being again needed for the restoration of the required depth of navigation, the dredge of the Lydon & Drews Company, contractors, began operations on May 9. The channel across the bar was dredged for a width of 120 feet and average length of 215 feet to a depth of 20 feet. Between the projecting part of the piers, the channel was deepened for a length of about 900 feet and width of 60 feet to 18 feet, and a single cut 30 feet wide and 16 feet deep was made in the river from near the inner end of the revetments to the winding basin, a distance of 2,090 feet. The latter cut was widened at both ends for greater ease in entering it. The dredging was completed June 8, and resulted in the removal of 33,384 cubic yards of sand, and in the restoration of a channel 18 feet deep and 120 feet wide across the bar, 60 feet wide and 16 feet deep between the piers, and 30 feet wide and 14 feet deep in the river to the winding basin. The stated depths refer to the level of zero of gauge. The Dunkley-Williams Transportation Company at its own expense deepened part of the winding basin and the channel leading to its docks.

The outer end of the north pier, which was run into by the steamer *City of Kalamazoo*, of the Dunkley-Williams Line on June 7, 1902, and seriously damaged, was substantially repaired between October 8 and December 21, under contract with Nelson J. Gaylord. The channel side corner had been destroyed for a depth of 15 feet below the top of the work. The broken timbers were all cut out and replaced by new ones, thoroughly secured by means of vertical corner timbers, screw bolts, and driftbolts. The stone filling and the deck were replaced, and the structure is now as strong as before the accident. The attempt to collect the cost of the repairs from the Dunkley-Williams Company through the United States district attorney has so far been unsuccessful.

On September 22 the steamer *Petoskey* ran into the south revetment near station 1+55 and broke the front wale and two piles. The damage has been repaired under a special agreement with J. M. Allmendinger, and the cost of the repairs collected from the Dunkley-Williams Company, the owners of the steamer.

\* \* \* \* \*

CONDITION OF WORK JUNE 30, 1903.

This is as reported in the Report of the Chief of Engineers for 1901, page 3085, except for the additional deterioration due to the lapse of two years.

# APPENDIX O O—REPORT OF LIEUT. COL. M. B. ADAMS. 1943

The channel between the piers has never been dredged to its full capacity, and this should be done. The channel in the river is narrow and needs widening. The enlargement of the channel to its full capacity is made especially desirable because of the increasing importance of the commerce of this harbor.

## WORK PROPOSED FOR FISCAL YEAR ENDING JUNE 30, 1904.

The approved project for this harbor, so far as new construction is concerned, is completed. With the available balance it is proposed to refill 667 linear feet of piers, at a cost of about \$2,000, and to devote the remainder to additional dredging when required.

## ESTIMATE OF FUNDS FOR FISCAL YEAR ENDING JUNE 30, 1905.

As stated, new construction under the existing project is completed. Dredging will, however, continue to be increasingly necessary, at large annual expense, until the piers are carried at least as far as the 16-foot contour of Lake Michigan. The following estimate for maintenance is submitted:

Dredging and incidental repairs.....	\$15,000.00
Total amount appropriated and allotted to June 30, 1903 .....	312,800.00
Miscellaneous receipts.....	81.20
	<hr/> 312,881.20
Total amount expended from March, 1867, to June 30, 1903:	
For construction.....	\$187,232.83
For maintenance .....	120,367.40
	<hr/> 307,600.23
Balance .....	4,780.97
Estimated cost of the work, 1866, amended in 1869, 1872, 1892, and 1898.....	297,000.00

## Money statement.

July 1, 1902, balance unexpended.....	\$12,334.41
Miscellaneous receipts .....	81.20
	<hr/> 12,415.61
June 30, 1903, amount expended during fiscal year.....	7,634.64
	<hr/> 4,780.97
July 1, 1903, balance unexpended.....	4,780.97
July 1, 1903, outstanding liabilities .....	36.87
	<hr/> 4,744.30
July 1, 1903, balance available .....	4,744.30
July 1, 1903, amount covered by uncompleted contracts.....	550.84
	<hr/> 15,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1905, for maintenance of improvement, in addition to the balance unexpended July 1, 1903 Submitted in compliance with requirements of sundry civil act of June 4, 1897, and of section 7 of the river and harbor act of 1899.	

# 1944 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

## APPROPRIATIONS.

March 2, 1867	\$43,000.00	July 5, 1884	\$7,500.00
July 11, 1870	10,000.00	August 5, 1886	5,000.00
March 3, 1871	15,000.00	August 11, 1888	10,000.00
June 10, 1872	12,000.00	September 19, 1890	15,000.00
March 3, 1873	20,000.00	July 13, 1892	10,000.00
June 23, 1874	10,000.00	August 18, 1894	20,000.00
March 3, 1875	10,000.00	June 3, 1896	15,000.00
August 14, 1876	10,000.00	March 3, 1899	45,000.00
June 18, 1878	12,000.00	June 6, 1900 (allotments)	3,300.00
March 3, 1879	7,500.00	June 13, 1902	12,000.00
June 14, 1880	5,000.00	Miscellaneous receipts	81.20
March 3, 1881	5,000.00		
August 2, 1882	10,000.00	Total	312,381.20

## ABSTRACT OF CONTRACTS IN FORCE.

### *Emergency contract for dredging.*

Contractor: Samuel O. Dixon.  
Date of contract: May 7, 1902.  
Date of beginning: May 13, 1902.  
Date of expiration: July 12, 1902.  
Rate: 18½ cents per cubic yard.

### *Dredging.*

Contractor: The Lydon & Drews Company.  
Date of contract: March 26, 1903.  
Date of approval: May 6, 1903.  
Date of beginning: May 24, 1903.  
Date of expiration: October 9, 1903.  
Rate: 16½ cents per cubic yard.

### *Emergency contract for repair of outer end of north pier.*

Contractor: Nelson J. Gaylord.  
Date of contract: September 25, 1902.  
Date of beginning: October 10, 1902.  
Date of expiration: December 15, 1902.  
Rates: Cutting down and removing old work, lump sum of \$550; white oak timber, \$60 per M feet B. M.; white pine timber, \$45 per M feet B. M.; hemlock timber, \$70 per M feet B. M.; white pine plank for decking, \$30 per M feet B. M.; securing in place in the work driftbolts at 50 cents each, screw bolts at 75 cents each and spikes at 5 cents each.

## COMMERCIAL STATISTICS FOR CALENDAR YEAR ENDING DECEMBER 31, 1902.

[Compiled from statement furnished by deputy collector of customs at South Haven, Mich.]

Character of vessels.	Number.	Tonnage.
Steam	1,101	495,144
Sail	86	1,080
Total	1,186	496,224

Maximum draft, 13.6 feet.

*Receipts and shipments by vessel, 1902.*

Articles received.	Tons.	Articles shipped.	Tons.
Flour .....	13, 142	Fruit .....	45, 140
Lumber .....	68, 250	Unclassed freight .....	20, 113
Unclassed freight .....	18, 400		
Total .....	90, 792	Total .....	65, 253
			Tons.
Total freight carried in 1902 .....			165, 045
Total freight carried in 1901 .....			56, 759
Increase .....			108, 286

During the year a new line was established between South Haven and Milwaukee in connection with the Michigan Central Railroad, furnishing through service between the Northwest and East; and the Fruit Growers' Transportation Company put into service between South Haven and Chicago the steamer *R. J. Gordon*.

There are under construction for use at this harbor two steel steamers, each 260 feet long, one for the Dunkley-Williams Company and the other for the Michigan Steamship Company.

## O O 4.

## IMPROVEMENT OF HARBOR OF SAUGATUCK, AND KALAMAZOO RIVER, MICHIGAN.

The history of these works is brought to the beginning of the fiscal year in the Report of the Chief of Engineers for 1902, pages 2149 and 2150.

## OPERATIONS DURING FISCAL YEAR ENDING JUNE 30, 1903.

The available depth in the navigable channel at the beginning of the fiscal year was insufficient for the needs of the vessels using this harbor, as shown by the soundings made June 21-23, 1902. The depths, referred to the level of zero of gauge, or 581.28 feet above mean tide at New York, found at that time, were as follows: Seven and five-tenths feet on the crossing of the outer bar; 9 feet in a narrow channel between the piers, and 8 feet on the first shoal above the bend. The stage of the lake at the time of soundings was 1.2 to 1.3 feet below zero gauge. Accordingly, dredging was commenced August 13, under the contract with Samuel O. Dixon, dated July 31, 1902, by which a channel 90 feet wide, 500 feet long, and 14 feet deep below zero of gauge across the outlying bar, extending 300 feet up between the piers with a width of 60 feet, a channel 60 feet wide, about 700 feet long, and 12 feet deep below zero through the first shoal above the bend, and a cut 30 feet wide, 300 feet long, and 10 feet deep through the second shoal above the bend was excavated. The dredging was completed September 17. The material dredged measured 21,627 cubic yards, and an 8-foot navigation at the existing stage was restored for the time being.

In the spring of 1903, the channel made in the previous year was found to be again obliterated. Soundings made April 10-13, 1903, showed the following available depths, referred to the level of zero of gauge: In front of the entrance, 7.9 feet; in the lower reach of the harbor, 8.3 feet; on the first shoal above the bend, 5.9 feet, and on the second shoal above the bend, 8.7 feet. The stage of the lake

## 1946 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

at the time of soundings varied from 0.8 to 1.6 feet below zero of gauge. This condition again necessitated dredging for the restoration of the needed depth of navigation, and on June 16 the dredge of the Lydon & Drews Company, contractors, commenced operations. The progress of dredging at this harbor is always slow in the beginning on account of the insufficient depth for the proper manipulation of tugs and dump scows. The unavoidable delays caused by this situation explain the small amount of work done up to the end of the fiscal year, which has consisted in making two cuts across the bar, each 30 feet wide and 14 feet deep below zero of gauge, and 390 feet of a cut 12 feet deep, inside. The dredged material measured 9,502 cubic yards.

The amount of available funds for the project of opening a new channel from Kalamazoo River to Lake Michigan having been increased to \$114,907.11 by the appropriation of \$100,000 in the sundry civil act of March 3, 1903, plans and specifications for the construction of the two piers forming part of the proposed new improvement were prepared, and on June 17 bids were opened for doing the work.

### CONDITION OF WORK JUNE 30, 1903.

This remains as described in the Report of the Chief of Engineers for 1900, page 3888, with the added deterioration due to the lapse of three years.

No work has yet been done on the Kalamazoo River project.

### WORK PROPOSED FOR FISCAL YEAR ENDING JUNE 30, 1905.

With the funds now available for the maintenance of the old entrance, it is proposed to complete the dredging now in progress under the contract with the Lydon & Drews Company for the temporary restoration of the needed depth of navigation, reserving the remaining balance for such additional dredging as may become necessary.

The sundry civil act of March 3, 1903, appropriated \$100,000 for the Kalamazoo River project, making the total amount available for that work \$114,907.11. On June 17, 1903, bids were opened for the construction of the two parallel piers from the shore line to the outer end of the improvement, and the lowest bid, involving an estimated cost of about \$82,600, has been recommended for acceptance. The specifications provide that the work must be completed before December 31, 1904. Of the remaining balance it is proposed to allot \$24,000 as part payment of the new hydraulic dredge and to reserve the remainder for contingencies.

### ESTIMATE OF FUNDS FOR FISCAL YEAR ENDING JUNE 30, 1904.

As the proposed new entrance to be created under the Kalamazoo River project can not possibly become available before the end of the calendar year 1905, it will be necessary to maintain the existing entrance in serviceable condition until that time, or for two seasons. Past experience proves that not less than \$7,500 is required each year for the temporary restoration of an approximately satisfactory channel, and the estimate, therefore, is \$15,000 for this purpose.

The original estimate for the Kalamazoo River project was \$250,000. Of this \$115,000 has been made available by past appropriations, leaving \$135,000 still to be appropriated. As stated above, the funds



# APPENDIX O O—REPORT OF LIEUT. COL. M. B. ADAMS. 1947

now available are to be applied to the construction of the projecting piers, and the new entrance can not become available for the use of navigation before the completion of the entire project. The estimate presented herewith, therefore, calls for the entire amount remaining to be appropriated, viz, \$135,000.

Total amount appropriated and allotted to June 30, 1903 .....	\$311,939.00
Total amount expended from July, 1868, to June 30, 1903:	
For construction .....	\$90,883.91
For maintenance .....	96,513.94
	<u>186,897.85</u>
Balance .....	125,041.15
Estimated cost of existing project for Saugatuck Harbor, 1867, modified 1869, 1870, 1875, 1882, and 1892 .....	175,699.46
Estimated cost of existing Kalamazoo River project, approved June 3, 1896, and May 31, 1900 .....	250,000.00

## *Money statement.*

July 1, 1902, balance unexpended .....	\$29,941.51
Amount appropriated by sundry civil act approved March 3, 1903 .....	100,000.00
	<u>129,941.51</u>
June 30, 1903, amount expended during fiscal year .....	4,900.36
July 1, 1903, balance unexpended .....	125,041.15
July 1, 1903, outstanding liabilities .....	96.66
	<u>124,944.49</u>
July 1, 1903, balance available .....	5,000.00
July 1, 1903, amount covered by uncompleted contracts .....	<u>135,000.00</u>
(Amount (estimated) required for completion of existing project .....	135,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1905, in addition to the balance unexpended July 1, 1903:	
For works of improvement .....	\$135,000.00
For maintenance of improvement .....	15,000.00
	<u>150,000.00</u>
Submitted in compliance with requirements of sundry civil act of June 4, 1897, and of section 7 of the river and harbor act of 1899.	

## APPROPRIATIONS FOR IMPROVING SAUGATUCK HARBOR AND KALAMAZOO RIVER, MICHIGAN.

Date.	Saugatuck Harbor.	Kalamazoo River.	Total.
July 25, 1868 (allotment) .....	\$23,900		\$23,900
April 10, 1869 (allotment) .....	6,039		6,039
July 11, 1870 .....	10,000		10,000
March 3, 1871 .....	10,000		10,000
June 10, 1872 .....	15,000		15,000
March 3, 1873 .....	10,000		10,000
June 23, 1874 .....	10,000		10,000
March 3, 1875 .....	10,000		10,000
August 14, 1876 .....	3,000		3,000
June 18, 1878 .....	2,500		2,500
March 3, 1879 .....	5,000		5,000
June 14, 1880 .....	5,000		5,000
March 3, 1881 .....	5,000		5,000
August 2, 1882 .....	8,000		8,000
July 5, 1884 .....	4,000		4,000
August 5, 1886 .....	8,000		8,000
August 11, 1888 .....	5,000		5,000
July 13, 1892 .....	5,000		5,000
August 18, 1894 .....	12,000		12,000
June 3, 1896 .....	10,000	\$5,000	15,000
March 3, 1899 .....	7,000	10,000	17,000
June 6, 1900 (allotments) .....	7,500		7,500
June 13, 1902 .....			15,000
March 3, 1903 .....		100,000	100,000
Total .....	<u>181,939</u>	<u>115,000</u>	<u>311,939</u>

# 1948 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

## ABSTRACT OF CONTRACTS IN FORCE.

### *Emergency contract for dredging.*

Contractor: Samuel O. Dixon.  
 Date of contract: July 31, 1902.  
 Date of beginning: August 6, 1902.  
 Date of expiration: October 6, 1902; time limit waived.  
 Rate: 20 cents per cubic yard.

### *Dredging.*

Contractor: The Lydon & Drews Company.  
 Date of contract: March 26, 1903.  
 Date of approval: May 6, 1903.  
 Date of beginning: May 24, 1903.  
 Date of expiration: October 9, 1903.  
 Rate: 16½ cents per cubic yard.

## COMMERCIAL STATISTICS FOR SAUGATUCK HARBOR, MICHIGAN, CALENDAR YEAR ENDING DECEMBER 31, 1902.

[Compiled from statement furnished by Messrs. Griffin & Henry, of Saugatuck, Mich.]

Character of vessels.	Number.	Tonnage.
Steam .....	790	101,208
Sail .....	18	548
Total .....	808	101,756

Maximum draft, 8 feet.

### *Receipts and shipments by vessel, 1902.*

Articles received.	Tons.	Articles shipped.	Tons.
Coal .....	3,500	Fruit .....	2,881
Lime .....	75	Miscellaneous .....	552
Lumber .....	1,875		
Shingles .....	750		
Laths .....	60		
Cedar posts .....	60		
Miscellaneous .....	2,000		
Total .....	8,410	Total .....	3,433

## O O 5.

### IMPROVEMENT OF HARBOR AT HOLLAND (BLACK LAKE), MICH.

The history of this work is brought to the close of the last fiscal year in the Report of the Chief of Engineers for 1902, pages 2152 and 2153.

### OPERATIONS DURING FISCAL YEAR ENDING JUNE 30, 1903.

Soundings made March 25-30, 1903, showed the following available depths, referred to the level of zero of gauge, or 581.28 feet above mean

tide at New York: Ten and two-tenths feet in mid-channel at outer end of piers, while close to south pier there was a narrow passage 16 feet deep, 12.5 feet near shore line, thence deepening to 14 feet at the Black Lake end of the channel. The stage of the lake at the time of soundings was from 1.3 to 1.7 feet below zero of gauge. To improve this condition, dredging was commenced May 11 under the contract with The Lydon & Drews Company. The channel from 300 feet inside of the piers to the 18-foot curve outside was dredged for a width of 120 feet to a depth of 19 feet below zero. From 300 feet inside the piers for a length of 900 feet the channel was dredged 60 feet wide and 17 feet deep, and thence it was widened by a single cut 30 feet wide and 17 feet deep for a length of 850 feet to Black Lake. An additional cut 240 feet long, 30 feet wide, and 17 feet deep removed a shoal spot from the channel north of the previously mentioned cut. The dredging resulted in the restoration of a channel 120 feet wide and 17 feet deep below zero of gauge at the entrance, and 60 feet wide and 15 feet deep below zero inside. Besides the above-described work a cut 14 feet deep was made along the face of the south revetment for the removal of obstructions which might interfere with the driving of sheet piles. The dredging was completed June 15, and the total quantity of material removed was 35,571 cubic yards.

Under date of May 18 a contract was entered into with Robert Love & Co. for repairing the north pier between stations 0 and 2+55 and between stations 12+64 and 17+98 and the south pier between stations 0+05 W and 2+02, and between stations 11+74 and 16+86. The work, which is to be begun July 1, 1903, is to be completed within six working months, and not later than August 1, 1904.

#### CONDITION OF WORK JUNE 30, 1903.

The condition of the navigable channel has been described under the head of operations. The condition of the piers and revetments is practically as reported on page 3902, Report of the Chief of Engineers for 1901, and on page 2152, Report of the Chief of Engineers for 1902, except that the south pier near station 1+75 was run into on July 25, 1902, by the U. S. S. *Dorothea*, cutting through the seven upper courses of the channel wall. All the defective and worn-out portions of the piers are included in the work to be done under the contract with Robert Love & Co., and when these shall have been completed the existing works will be in good condition.

#### WORK PROPOSED FOR FISCAL YEAR ENDING JUNE 30, 1904.

Under the contract with Robert Love & Co. the defective or worn-out portions of the piers and revetments will be repaired at an estimated cost of \$23,306. Of the balance of the available funds \$20,000 is to be allotted as part payment of the new hydraulic dredge and \$1,000 as part payment of a new inspection steamer. The remainder will be reserved for additional dredging, incidental repairs, and contingencies.

#### ESTIMATE OF FUNDS FOR FISCAL YEAR ENDING JUNE 30, 1905.

The piers at this harbor have not been extended since 1880, and in the meantime the shore line on both sides has advanced and the lake

1950 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

bottom in the neighborhood of the entrance has shoaled so that the natural depth is but 7 to 8 feet. The present approved project calls for a 16-foot channel, which is urgently needed by the navigation interests. To provide this channel, the approved project provides for extending the north pier 800 feet and the south pier 700 feet. It is thought to be probable that dredging on an extensive scale at and beyond the entrance, with the new seagoing hydraulic dredge, will have the effect of rendering this large amount of pier extension unnecessary for the creation and preservation of the proposed depth of channel; but the present end of the piers, although the water in their immediate vicinity is comparatively deep, project only to about the mean 10-foot curve in the lake, and it is believed that the harbor would be in better condition to insure a somewhat reliable channel of the proposed depth if the piers were given an additional projection of about 400 feet. The channel has never been dredged to its full width and depth, on account of the inefficient condition and insecure foundation of the piers and revetments. Upon the completion of the repair work now to be begun under the contract with Robert Love & Co., these difficulties will be removed, and it will be practicable to dredge the channel to the full capacity proposed by the approved project. This will require the removal of about 65,000 cubic yards of material, at an estimated cost of \$10,000. The estimate for maintenance is \$5,000 for dredging during another season, and \$5,000 for incidental repairs.

The total estimate is therefore as follows:

For new construction and dredging:	
600 feet cribwork, at \$90 .....	\$54,000
200 feet cribwork, at \$120 .....	24,000
Dredging channel to full capacity .....	10,000
	<hr/>
	88,000
Add 10 per cent for contingencies .....	8,800
	<hr/>
	\$96,800
For maintenance:	
Dredging .....	5,000
Incidental repairs .....	5,000
	<hr/>
	10,000
Total .....	<hr/>
	106,800
Total amount appropriated and allotted to June 30, 1903 .....	
	\$419,315.31
Miscellaneous receipts .....	1,100.00
	<hr/>
	420,415.31
Less amount carried to surplus fund .....	1.19
	<hr/>
	420,414.12
Total amount expended from August, 1852, to March 3, 1899:	
For construction .....	\$176,619.80
For maintenance .....	127,597.50
	<hr/>
	304,217.30
Total amount expended to June 30, 1903, on project approved March 3, 1899:	
For construction .....	34,457.10
For maintenance by dredging .....	14,324.73
	<hr/>
	48,781.83
Balance .....	<hr/>
	67,414.99
Estimated cost of existing project approved March 3, 1899 .....	240,000.00

*Money statement*

July 1, 1902, balance unexpended .....	\$76,852.86
Miscellaneous receipts .....	1,100.00
	<hr/> 77,452.86
June 30, 1903, amount expended during fiscal year .....	10,037.87
	<hr/> 67,414.99
July 1, 1903, balance unexpended .....	67,414.99
July 1, 1903, outstanding liabilities .....	50.00
	<hr/> 67,364.99
July 1, 1903, balance available .....	67,364.99
	<hr/> 23,892.92
July 1, 1903, amount covered by uncompleted contracts .....	23,892.92
	<hr/> 129,500.00
Amount (estimated) required for completion of existing project .....	129,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1905, in addition to the balance unexpended July 1, 1903:	
For works of improvement .....	\$96,800.00
For maintenance of improvement .....	10,000.00
	<hr/> 106,800.00
Submitted in compliance with requirements of sundry civil act of June 4, 1897, and of section 7 of the river and harbor act of 1899.	

## APPROPRIATIONS.

*Black Lake:*

August 30, 1852 .....	\$8,000.00
June 23, 1866 .....	55,615.31
March 2, 1867 .....	51,000.00
July 11, 1870 .....	10,000.00
March 3, 1871 .....	10,000.00
June 10, 1872 .....	10,000.00
March 3, 1873 .....	12,000.00
June 23, 1874 .....	15,000.00
March 3, 1875 .....	15,000.00
August 14, 1876 .....	15,000.00
June 18, 1878 .....	10,000.00
March 3, 1879 .....	6,000.00
June 14, 1880 .....	6,000.00
March 3, 1881 .....	6,000.00
August 2, 1882 .....	10,000.00
July 5, 1884 .....	15,000.00
August 5, 1886 .....	5,000.00

*Black Lake—Continued.*

August 11, 1888 .....	\$5,000.00
September 19, 1890 .....	10,000.00
Holland:	
July 13, 1892 .....	5,000.00
August 18, 1894 .....	15,000.00
June 3, 1896 .....	10,000.00
March 3, 1899 .....	37,500.00
June 6, 1900 (allotments) .....	4,200.00
June 13, 1902 .....	78,000.00
Miscellaneous receipts .....	1,100.00
	<hr/> 420,415.31
Total .....	420,415.31
Amount carried to surplus fund .....	1.19
	<hr/> 420,414.12

## ABSTRACT OF CONTRACTS IN FORCE.

*Emergency contract for dredging.*

Contractor: Samuel O. Dixon.  
Date of contract: May 7, 1902.  
Date of beginning: May 13, 1902.  
Date of expiration: July 12, 1902.  
Rate: 18½ cents per cubic yard.

*Dredging.*

Contractor: The Lydon & Drews Company.  
Date of contract: March 26, 1903.  
Date of approval: May 6, 1903.  
Date of beginning: May 24, 1903.  
Date of expiration: October 9, 1903.  
Rate: 16½ cents per cubic yard.

1952 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

*Repair of piers.*

Contractor: Robert Love & Co.

Date of contract: May 18, 1903.

Date of approval: June 1, 1903.

Date of beginning: July 1, 1903.

Date of expiration: August 1, 1904, or within six working months from date of beginning.

Rates:

Cutting down and removing old work, \$3 per linear foot.

White-oak piles, 33 cents per linear foot.

White-oak timber, \$45 per M feet B. M.

White pine, long leaf yellow pine, or Douglas fir timber, \$33 per M feet B. M.

White pine, long leaf yellow pine, or Douglas fir plank for sheet piles, \$42 per M feet B. M.

White pine or long leaf yellow pine planks for decking, \$30 per M feet B. M.

Driftbolts, screw bolts, carriage bolts, tie-rods, and spikes, 3½ cents per pound.

---

COMMERCIAL STATISTICS.

NOTE.—Owing to the death of the former deputy collector of customs at the port of Holland, it has been impossible to procure any data relative to commercial statistics for the calendar year 1902 for this harbor.

---

O O 6.

IMPROVEMENT OF GRAND HAVEN HARBOR, MICHIGAN.

The history of this work is brought to the close of the last fiscal year in the Report of the Chief of Engineers for 1902, pages 2155–6.

OPERATIONS DURING FISCAL YEAR ENDING JUNE 30, 1903.

During the past year operations at the harbor consisted in dredging the channel of Grand River at the locality called "The Sag" and the channel leading from Grand River to Spring Lake, in making various repairs to the south pier, and in beginning the work of repairing the north pier between stations 0 and 6+09 E.

The dredging operations were performed by the U. S. dredge *Farquhar* and the attendant Government scows and tug. The channel of Grand River at "The Sag," a locality situated between Grand Haven and Spring Lake, was dredged for a width of 75 feet and average length of about 1,400 feet to a depth of 16.5 feet below the level of zero of gauge. The channel between Grand River and Spring Lake was dredged to the depth of 16.5 feet below zero of gauge for a width of 60 feet below the highway bridge, for the width of the draw spans through the bridges, and for a width of 90 feet above the railroad bridge. The material dredged measured 14,533 cubic yards. The work was done in August and September, 1902.

The repairs of the north pier between stations 0 and 6+09 are being made under a contract dated February 21, 1903, with Robert Millen & Co. Operations under this contract were begun in March, and up to the end of the fiscal year the old superstructure had been removed, the substructure repaired where required, and the timber work of the new superstructure was nearly completed. It is expected that this work will be finally completed by the middle of July.

The repairs made by day labor and purchased material were as follows: The plank walk on the south revetment between stations 8+03.8 and 22+85 was repaired by removing the broken and unsafe planks and replacing them by planks saved from the walk between stations 22+85 and 46+41.5. The latter part of the walk was entirely rebuilt with new material.

The break in the channel wall of the south revetment between stations 42+02.7 and 42+60.2, caused by the steamer *Charles H. Hackley* on June 3, 1902, was repaired by driving 6 new piles in the front wall, putting on a new front wale, and strengthening the front wall of the superstructure with new timbers and screwbolts. The cost of these repairs has been refunded by Barry Brothers, the owners of the steamer, as also the estimated cost of repairing the damage done by the steamer *Alice Stafford* of the same line on June 26 to the inner end of the south pier.

#### CONDITION OF WORK JUNE 30, 1903.

This remains practically as described in annual report for 1902, page 2156, except for the repairs above noted. But the filling in the south revetment has settled considerably, and the river bottom along the face of part of this work has been eroded to such a depth that the structure requires heavy riprapping for its support and safety. Besides, two other cases of damage have occurred during the year by colliding vessels.

On October 13 the steamer *Frontenac* ran into the south pier and tore out five courses of timber below the water surface between stations 2+68 and 2+74 E and damaged the superstructure timbers above.

On October 19 the steamer *Charles H. Hackley*, of the Barry Line, collided with the east end of the south revetment, practically ruining the upper portion of this work for a length of about 110 feet. A settlement has been effected with the owners of the *Hackley* through the United States district attorney for this damage.

The condition of the channel at the close of the fiscal year, as shown by soundings made June 9, was as follows, the depths being reduced to the level of zero of gauge: On the bar in front of the entrance, 17.8 feet on line of north pier; 17.5 feet on the shoalest point 100 feet south of line of north pier, and 20.5 feet on line of south pier. In the channel at end of piers the shoalest point was 160 feet north of south pier, with 16.9 feet. The stage of the lake at the time of soundings was 0.8 to 1.5 feet below zero of gauge.

#### WORK PROPOSED FOR FISCAL YEAR ENDING JUNE 30, 1904.

The repairs of the north pier between stations 0 and 6+09 E under the contract with Robert Millen & Co. will be completed. The material required for the repairs of the parts of the south pier damaged by colliding vessels has been purchased and the repairs will be commenced in July by day labor and completed. Of the remaining balance, an allotment of \$4,300 will be reserved for part payment of an inspection steamer and the rest for incidental repairs and dredging.

#### ESTIMATE OF FUNDS FOR FISCAL YEAR ENDING JUNE 30, 1905.

The existing project provides for an extension of 100 feet to the south pier and of 150 feet to the north pier. It is anticipated, however, that these extensions will be rendered unnecessary for some

# 1954 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

time to come by the thorough dredging proposed to be done with the new hydraulic dredge when it becomes available, and the estimate for this purpose is therefore postponed. The estimate presented herewith is for maintenance only, viz, \$5,000 for refilling and riprapping the south revetment, \$5,000 for general repairs, and \$10,000 for dredging, making in all \$20,000.

*Monthly record of Grand Haven automatic gauge for fiscal year July 1, 1902, to June 30, 1903.*

[The zero of gauge is 3.06 feet below high water of 1838.]

Date.	Number of days.	Sum for month.	Monthly mean.	Highest reading.		Lowest reading.	
				Day.	Reading.	Day.	Reading.
1902.							
July.....	31	<i>Feet.</i> -26.572	<i>Feet.</i> -0.857	July 18	-0.07	July 16	-1.67
August.....	31	-27.404	-0.884	Aug. 20	- .46	Aug. 7	-1.42
September.....	30	-34.205	-1.140	Sept. 3	- .36	Sept. 7	-1.63
October.....	31	-40.181	-1.295	Oct. 13	- .35	Oct. 20	-1.72
November.....	30	-42.822	-1.427	Nov. 15	- .45	Nov. 30	-2
December.....	31	-50.928	-1.643	Dec. 15	- .55	Dec. 17	-2.50
1903.							
January.....	31	-58.756	-1.895	Jan. 7	- .88	Jan. 31	-2.53
February.....	28	-49.419	-1.765	Feb. 4	- .80	Feb. 10	-2.40
March.....	31	-46.764	-1.508	Mar. 24	- .50	Mar. 1	-2
April.....	30	-33.459	-1.115	Apr. 30	- .20	Mar. 21	-2
May.....	31	-32.953	-1.063	May 26	+ .10	Apr. 1	-1.96
June.....	30	-29.226	- .974	June 30	- .40	May 26	-1.76
						June 30	-1.97
Sum.....	365	-472.639	.....	May 26	+ .10	Jan. 31	-2.53

Mean daily stage for year,  $-472.639 \div 365 = -1.295$ .

Total amount appropriated and allotted to June 30, 1903 ..... \$779,866.15  
Miscellaneous receipts ..... 5,576.92

784,943.07

Total amount expended from August, 1852, to June 30, 1903:

For construction ..... \$542,976.82  
For maintenance ..... 223,089.16

766,065.98

Balance ..... 18,877.09  
Original estimated cost of work, 1866, amended in 1880, 1890, and 1892. 804,866.15

## Money statement.

July 1, 1902, balance unexpended ..... \$22,592.71  
Miscellaneous receipts ..... 5,570.75

28,163.46

June 30, 1903, amount expended during fiscal year ..... 9,286.37

July 1, 1903, balance unexpended ..... 18,877.09  
July 1, 1903, outstanding liabilities ..... 246.00

July 1, 1903, balance available ..... 18,631.09

July 1, 1903, amount covered by uncompleted contracts ..... 5,408.79

{ Amount (estimated) required for completion of existing project ..... 25,000.00  
Amount that can be profitably expended in fiscal year ending June 30, 1905, for maintenance of improvement, in addition to the balance unexpended July 1, 1903. .... 20,000.00  
Submitted in compliance with requirements of sundry civil act of June 4, 1897, and of section 7 of the river and harbor act of 1899.



# APPENDIX O O—REPORT OF LIEUT. COL. M. B. ADAMS. 1955

## APPROPRIATIONS.

August 30, 1852 (mouth of Grand River).....	\$2,000.00	June 14, 1880'.....	\$50,000.00
June 23, 1866.....	65,000.00	March 3, 1881.....	50,000.00
March 2, 1867 (mouth of Grand River).....	40,000.00	August 2, 1882.....	40,000.00
April 10, 1869 (allotment)...	1,868.15	July 5, 1884.....	50,000.00
July 11, 1870.....	10,000.00	August 5, 1886.....	80,000.00
1870 (allotment).....	500.00	August 11, 1888.....	25,000.00
March 3, 1871.....	6,000.00	September 19, 1890.....	75,000.00
June 10, 1872.....	15,000.00	July 13, 1892.....	90,000.00
March 3, 1873.....	75,000.00	August 18, 1894.....	25,000.00
June 23, 1874.....	50,000.00	June 3, 1896.....	20,000.00
August 14, 1876.....	15,000.00	March 3, 1899.....	10,000.00
June 18, 1878.....	15,000.00	June 13, 1902.....	10,000.00
March 3, 1879.....	9,000.00	Miscellaneous receipts.....	5,576.92
		Total.....	784,943.07

## ABSTRACT OF CONTRACTS IN FORCE.

### *Repair of north pier.*

Contractor: Robert Millen & Co.

Date of contract: February 21, 1903.

Date of approval: March 12, 1903.

Date of beginning: April 15, 1903.

Date of expiration: November 1, 1903.

Rates: Cutting down and removing old work, \$2.25 per linear foot; white pine, long-leaf yellow pine, or Douglas fir timber, \$31 per M feet B. M.; white-pine or long-leaf yellow-pine plank for decking, \$30 per M feet B. M.; securing in place in the work driftbolts at one-half cent each and spikes at one-half cent each.

## COMMERCIAL STATISTICS FOR CALENDAR YEAR ENDING DECEMBER 31, 1902.

[Compiled from statements furnished by collector of customs at Grand Haven, Mich., and Capt. J. F. Cavanaugh, United States watchman.]

Character of vessel.	Number.	Tonnage.
Steam.....	3,052	888,010
Sail.....	52	5,000
Other craft.....	73	10,000
Total.....	3,176	903,010

Maximum draft, 17 feet.

# 1956 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

## Receipts and shipments by vessel, 1902.

Articles received.	Tons.	Articles shipped.	Tons.
Flour .....	45,941	Flour .....	326
Feed .....	31,246	Sugar .....	682
Salt .....	1,300	Salt .....	498
Vinegar .....	50	Soda ash .....	371
Wool .....	258	Wool .....	65
Rags .....	225	Rags .....	24
Leaf tobacco .....	163	Beans .....	85
Clover seed .....	53	Paper .....	569
Paper .....	55	Plaster .....	1,104
Wheat .....	300	Iron, etc .....	30
Barley .....	2,713	Fish .....	188
Iron ore .....	43,123	Hay .....	223
Lumber .....	6,350	Ties .....	3,500
Leather .....	13	Leather and hides .....	363
Fish .....	444	Burlaps .....	662
Wood .....	78	Lard .....	50
Stone .....	60	Wood and wood pulp .....	287
Lime and cement .....	548	Stone and gravel .....	2,248
Merchandise, miscellaneous .....	33,599	Cider .....	188
		Lime and cement .....	555
		Fruit .....	340
		Merchandise, miscellaneous .....	45,746
Total .....	166,519	Total .....	58,114

	Tons.
Total freight carried in 1902 .....	224,633
Total freight carried in 1901 .....	173,883
Increase .....	50,750

007.

## IMPROVEMENT OF GRAND RIVER, MICHIGAN.

The history of this improvement to the beginning of the year is found in the report of the Chief of Engineers for 1902, page 2159.

### OPERATIONS DURING FISCAL YEAR ENDING JUNE 30, 1903.

Operations by day labor and the use of Government plant have been in progress during the year. Dredging with the *Farquhar* was commenced September 8 at County House bar, and between then and the end of the season operations were carried on at County House, Eastmanville, Deer Creek, and Trail Creek bars. The dredge went into winter quarters at Grand Haven December 19, 1902, since which time general repairs and changes have been made, or are being made, which are not yet completed. A contract with the Featherstone Foundry and Machine Company for an A frame and steel boom has not been completed, consequently no dredging has been done this season. The material dredged during the fall of 1902, consisting of sand, clay, cobble stones, and bowlders, amounted to 67,679 cubic yards, bringing the total since the beginning of the work up to 450,970 cubic yards.

The contraction works, or training walls, built during the year, are in continuation of those of prior years. Considerable repair work to

walls that had been injured by ice was also done during the year. Long and frequent rains produced a stage in the river that would not allow repair work to be commenced until August 28. Between that date and November 19 the walls of the upper 7 miles of the improvement were completely repaired. It was not possible, however, to complete this work between the eighth and nineteenth miles owing to the prevailing high stage of the river. The plant used for this work was laid up for the winter season at Grand Haven on November 25. During the winter and the following spring extensive repairs were made to the plant and a new steam hammer pile driver was improvised from old machinery on hand. The work of fitting out began early in May, and on the 22d of the same month actual construction was commenced on the twenty-third mile. At the close of the fiscal year 11,059 linear feet of new wall had been completed between the eighteenth and twenty-third miles, making the total length of wall constructed since the beginning of the work 106,041 feet.

#### CONDITION OF WORK JUNE 30, 1903.

This condition is illustrated on the accompanying maps,<sup>a</sup> which show the location and extent of all dredge cuts and training walls which have been made since the beginning of operations under the present project, and the available channel depths reduced to the mean summer stage from Grand Rapids to the mouth of Bass River, 23 miles below. From Bass River to Grand Haven no depth of less than 5 feet exists.

#### WORK PROPOSED FOR THE NEXT FISCAL YEAR.

The new suction dredge, which is now under course of construction for this improvement, will be completed in time to begin operations on the river when navigation opens in the spring of 1904. It will be employed in connection with the dipper dredge *Farquhar* in deepening the channel over all bars between Grand Rapids and the mouth of Bass River, 23 miles below, and depositing the material behind existing training walls. The *Farquhar* will be employed in the removal of such material as can not be handled by the new dredge.

The contraction works, which are being constructed during the present season, will leave this work much in advance of the dredging. It is therefore intended to postpone the construction of further work of this nature until the work of the dredges has made it imperative that more training walls be built.

#### ESTIMATE OF FUNDS FOR FISCAL YEAR ENDING JUNE 30, 1905.

The annual expenditure of small appropriations on this project is of doubtful expediency. Such a course will prolong the work far beyond the time contemplated in the original estimate of cost, will, on account of the cost of maintenance, greatly increase the amount necessary to complete the work, and, moreover, render the possibility of an ultimate completion of the project problematical from an engineering standpoint. It is therefore thought that nothing less than \$200,000 should be provided for the continuance of this work.

---

<sup>a</sup> Not printed.

# 1958 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

Total amount appropriated to June 30, 1903 .....	\$325,000.00
Total amount expended on previous project from March, 1881, to June, 1896 .....	50,000.00
Total amount expended on present project, approved June 3, 1896 .....	157,550.94
Balance .....	117,449.06
Original estimated cost of project, approved June 3, 1896 .....	870,500.00
Amended by act of June 13, 1902 .....	774,000.00

## Money statement.

July 1, 1902, balance unexpended .....	\$153,034.01
June 30, 1903, amount expended during fiscal year .....	35,584.95
July 1, 1903, balance unexpended .....	117,449.06
July 1, 1903, outstanding liabilities .....	3,683.91
July 1, 1903, balance available .....	113,765.15
{ Amount (estimated) required for completion of existing project ....	499,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1905, in addition to the balance unexpended July 1, 1903 .....	200,000.00
{ Submitted in compliance with requirements of sundry civil act of June 4, 1897.	

## APPROPRIATIONS.

March 3, 1881 .....	\$10,100	March 3, 1899 .....	\$75,000
August 2, 1882 .....	15,000	June 13, 1902 .....	150,000
July 5, 1884 .....	25,000		
June 3, 1896 .....	50,000	Total .....	325,000

## COMMERCIAL STATISTICS FOR CALENDAR YEAR ENDING DECEMBER 31, 1902.

[Compiled from statement furnished by Capt. J. F. Cavanaugh, United States watchman at Grand Haven, Mich.]

Character of vessel.	Number.	Tonnage.
Steam barges .....	84	69,468
Tugs, scows, etc. ....	234	27,800
Total .....	318	97,268

## Freight carried on Grand River, 1902.

	Tons.
Iron ore .....	48,864
Gravel .....	700
Wood, logs, etc. ....	5,590
Package freight .....	460
Total .....	55,614
* * * * *	*

O O 8.

## IMPROVEMENT OF MUSKEGON HARBOR, MICHIGAN.

The record of this improvement is brought to the beginning of the fiscal year in the Report of the Chief of Engineers for 1902, pages 2162-2163.

## OPERATIONS DURING FISCAL YEAR ENDING JUNE 30, 1903.

Dredging was in progress at the beginning of the fiscal year, under the contract with Samuel O. Dixon, for the deepening of the channel near shore line and through the bar in front of the entrance. The shoal near shore line was dredged for a length of 400 feet and width of 120 feet to a depth of 20 feet, and an area of 260 feet average length and 120 feet width was dredged to a depth of 22 feet on the bar. The work was completed July 14, and resulted in reestablishing a channel of navigable width and 17 feet deep below the level of zero of gauge from Lake Michigan to Muskegon Lake. The quantity dredged from July 1 to 14 was 8,093 cubic yards.

The channel shoaled again during the fall and winter, and in April only 14.7 feet was found in mid-channel near shore line. Systematic soundings made May 20-22 showed an available depth of 24 feet on the southern approach to the entrance; in the channel between the piers at outer end, 20 feet for a width of 60 feet next to south pier and 17.1 feet in mid-channel; at shore line, 15.4 feet for a width of 60 feet next to south pier, with 14.2 feet in mid-channel; thence to Muskegon Lake, 16 to 17 feet. The depths refer to the level of zero of gauge. The available depth at shore line was less than required by the deep-draft vessels frequenting the harbor, but as the two dredges furnished by the Lydon & Drews Company, contractors, were first needed at South Haven and Holland harbors, and as an attempt to secure a special dredge for service at Muskegon proved unsuccessful, the beginning of operations for restoring the required width and depth of the channel was delayed until June 18. The dredging, which has been in progress since then, has so far resulted in reestablishing a navigable channel in the two worst portions of the harbor near shore line. The material dredged between June 18 and 30 measured 18,865 cubic yards.

Under date of November 4, 1902, a contract was entered into with Robert Love for revetting the unprotected portions of the bank on the south side of the channel from the inner end of the south pier to Muskegon Lake and for repairing the south pier between stations 6+28.8 and 9+33. The new revetment is to consist of two parts, the first to extend from the inner end of the south pier, or station 3+04 E., to station 13+20, at the warehouse of the Pere Marquette Railroad, the second to begin at the easterly end of the revetment of the railroad slip, or at station 22+65, and to extend thence to station 35+12, and to be completed with a 50 by 24 foot crib extending to station 35+62, in Muskegon Lake. Operations under this contract were begun March 13, and the work done to the end of the fiscal year was as follows: For the revetment from stations 3+04 to 13+20, 154 front piles were driven from stations 3+04 to 9+17.5; 102 rear piles from stations 3+04 to 11+09.5; the front wale was put in place from stations 2+96.5 to 8+97.5; the upper guide, from stations 3+04 to 9+00; the lower guide, not yet secured, from stations 3+04 to 7+04; 249 compound sheet piles were driven from stations 3+03 to 5+60; the binder, not yet entirely secured, was put in place from stations 3+00 to 7+04; the rear wale from stations 3+00.5 to 9+17.5, and the tie-rods from stations 3+00 to 3+47. For the revetment from stations 22+65 to 35+12, 61 front piles were driven from stations 22+65 to 25+05.5; 33 rear piles from stations 22+75.5 to 25+29.5, and 3 piles in the crossrow at station 22+80; the front wale was put in place from stations 22+65 to 25+01.5; the upper guide from stations 22+65 to 24+96, and the lower

# 1960 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

guide, not yet secured, from stations 22+65 to 24+76; 208 compound sheet piles were driven from stations 22+65 to 24+82.5; the binder, only partly secured, was put in from stations 22+65 to 24+84, and the rear wale was secured from stations 22+74 to 24+81.5. The site for the crib to be placed at the east end was dredged to the required depth, and the 32 foundation piles for this crib were driven. The construction of the crib 50 by 24 by 18½ feet was completed. For the repairs of the south pier between stations 6+28.8 to 9+33, the elevated walk, range light, deck, and the superstructure between stations 6+28.8 and 8+62 were removed, a gap in the front wall of the substructure between stations 7+61.5 and 7+81.5 was repaired, and four courses of the new superstructure, beginning at station 6+28.8 and extending to stations 8+62, 8+54, 8+46, and 7+98, respectively, were built.

## CONDITION OF WORK JUNE 30, 1903.

When the repairs under way shall be completed, the timber work of the south pier and of the projecting portion of the north pier, with the exception of some breaks caused by colliding vessels, will be in fair condition, but the filling in many pockets has settled greatly. The condition of the interior portion of the north pier and revetment is bad for a great part of its length, but the adopted project provides for the removal of this portion and the construction of a new pier and revetment on a line about 300 feet distant from and parallel to the south pier.

By decision of the Secretary of War the Barry Brothers Transportation Company has been granted permission to make the required repairs of the break in the south pier near station 15, referred to in the annual report for 1901. Nothing has as yet been done by the company toward making the necessary repairs.

The condition of the channel has been fully described under the head of "operations."

## WORK PROPOSED FOR FISCAL YEAR ENDING JUNE 30, 1904.

The construction of the revetment of the south bank of the channel and the repairs of the south pier between stations 6+28.8 and 9+33, now under contract with Robert Love, will be completed. The balance of the available funds will be reserved for ordinary repairs, refilling of piers, and necessary dredging.

## ESTIMATE OF FUNDS FOR FISCAL YEAR ENDING JUNE 30, 1905.

The approved project provides for removing the interior portion of the north pier and revetment, the widening of the channel to about 300 feet and deepening it to 20 feet, the construction of a new pier and revetment on the north side of the channel, and for extending the south pier 200 feet and the north pier 350 feet. The pier extension may be postponed for the present, provided the necessary dredging is promptly and properly done. The estimate is therefore as follows:

Removing old pier and revetment (including contingencies)	\$28,600
500 feet of sheet-pile pier	27,500
3,852 of sheet-pile revetment	104,500
750,000 cubic yards dredging	82,500
	243,100
The estimate for maintenance is, for repairs and refilling	10,000
Total for new construction and maintenance	253,100

# APPENDIX O O—REPORT OF LIEUT. COL. M. B. ADAMS. 1961

Total amount appropriated and allotted to June 30, 1903 .....	\$604,500.00
Total amount expended on project, 1866, amended 1869, 1873, 1881, 1884, 1890, 1892, and 1899:	
For construction.....	\$388,218.42
For maintenance .....	138,074.94
	<u>526,293.36</u>
Total amount expended on project approved June 13, 1902, for main- tenance.....	6,856.16
Balance .....	71,350.48
Original estimated cost of work, 1866, amended in 1869, 1873, 1881, 1884, 1890, 1892, and 1899 .....	596,000.00
Estimated cost of revised project approved June 13, 1902.....	380,000.00

## *Money statement.*

July 1, 1902, balance unexpended.....	\$78,206.64
June 30, 1903, amount expended during fiscal year .....	6,856.16
	<u>71,350.48</u>
July 1, 1903, balance unexpended.....	71,350.48
July 1, 1903, outstanding liabilities .....	294.67
	<u>71,055.81</u>
July 1, 1903, balance available .....	71,055.81
July 1, 1903, amount covered by uncompleted contracts .....	56,891.65
	<u>305,000.00</u>
(Amount (estimated) required for completion of existing project ....	305,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1905, in addition to the balance unexpended July 1, 1903:	
For works of improvement.....	\$243,100.00
For maintenance of improvement .....	10,000.00
	<u>253,100.00</u>
Submitted in compliance with requirements of sundry civil act of June 4, 1897, and of section 7 of the river and harbor act of 1899.	

## APPROPRIATIONS.

March 2, 1867.....	\$59,000	August 5, 1886.....	\$12,500
July 11, 1870.....	10,000	August 11, 1888.....	45,000
March 3, 1871.....	15,000	September 19, 1890.....	50,000
June 10, 1872.....	10,000	July 13, 1892.....	75,000
June 23, 1874.....	10,000	August 18, 1894.....	30,000
March 3, 1875.....	25,000	June 3, 1896.....	30,000
August 14, 1876.....	15,000	March 3, 1899.....	60,000
March 3, 1879.....	5,000	June 6, 1900 (allotments).....	5,500
June 14, 1880.....	7,500	June 13, 1902.....	75,000
March 3, 1881.....	20,000		
August 2, 1882.....	25,000	Total.....	604,500
July 5, 1884.....	20,000		

## ABSTRACT OF CONTRACTS IN FORCE.

### *Emergency contract for dredging.*

Contractor: Samuel O. Dixon.  
Date of contract: May 7, 1902.  
Date of beginning: May 13, 1902.  
Date of expiration: July 12, 1902.  
Rate: 18½ cents per cubic yard.

# 1962 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

## *Dredging.*

Contractor: The Lydon & Drews Company.

Date of contract: March 28, 1903.

Date of approval: May 6, 1903.

Date of beginning: May 24, 1903.

Date of expiration: October 9, 1903.

Rate: 16½ cents per cubic yard.

## *Construction of revetment and repair of pier.*

Contractor: Robert Love.

Date of contract: November 4, 1902.

Date of approval: November 15, 1902.

Date of beginning: April 15, 1903.

Date of expiration: December 1, 1903.

Rates: Cutting down and removing old work, \$2.50 per linear foot; dredging, 85 cents per cubic yard; foundation piles, 50 cents per linear foot; white-oak piles, 80 cents per linear foot; white-oak timber, \$40 per M feet B. M.; long leaf yellow-pine timber, \$30 per M feet B. M.; hemlock timber, \$25 per M feet B. M.; long leaf yellow-pine plank for sheet piles, \$38 per M feet B. M.; long leaf yellow-pine plank for decking, \$27 per M feet B. M.; driftbolts, screw bolts, carriage bolts, tie-rods, and spikes, 8 cents per pound; stone, \$7.50 per cord; sand filling, 20 cents per cubic yard.

## COMMERCIAL STATISTICS FOR CALENDAR YEAR ENDING DECEMBER 31, 1902.

[Compiled from statement furnished by the deputy collector of customs at Muskegon, Mich.]

Character of vessels.	Number.	Tonnage.
Steam .....	902	754,430
Sail .....	227	24,355
Total .....	1,219	778,785

Maximum draft, 17 feet.

## *Receipts and shipments by vessel, 1902.*

Articles received.	Tons.	Articles shipped.	Tons.
Grain .....	2,500	Lumber, shingles, etc. ....	40,300
Flour .....	56	Flour .....	300
Lumber, shingles, etc. ....	27,755	Apples .....	30
Merchandise, miscellaneous .....	81,072	Merchandise, miscellaneous .....	75,000
Total .....	111,883	Total .....	115,630

	Tons.
Total freight carried in 1902 .....	227,013
Total freight carried in 1901 .....	176,368
Increase .....	50,645

O O 9.

## IMPROVEMENT OF HARBORS AT PENTWATER AND WHITE LAKE, MICHIGAN.

These harbors were formerly carried as separate works, but are now combined in consequence of the requirements of the river and harbor act of June 13, 1902.

The history of these works is brought to July 1, 1902, in report of the Chief of Engineers for 1902, pages 2166-2167.



## (a) PENTWATER HARBOR.

## OPERATIONS DURING FISCAL YEAR ENDING JUNE 30, 1903.

The condition of the Pentwater channel at the beginning of the fiscal year was such as to require dredging at the earliest practicable moment, but it was not until October 8 that one of the dredges of contractor Samuel O. Dixon became available for work at this harbor. Between this date and October 30 the channel across the outer bar was dredged for a width of 120 and average length of 160 feet to the depth of 17 feet below zero of gauge, and between the piers for a width of 60 feet and length of about 1,400 feet to the depth of 15 feet below zero of gauge. The dredged material measured 18,614 cubic yards. The resulting available depth outside of the entrance was 15 feet below zero of gauge and between the piers 14 feet.

No other work was done at Pentwater during the fiscal year, but a contract was entered into with Burk, Smith & Nelson, under date of March 13, 1903, for repairing the inner portion of the north pier for a length of 890 feet. Work under this contract is to commence on or before August 1, 1903, and to be completed November 15, 1903.

## (b) WHITE LAKE HARBOR.

At White Lake, dredging operations for the temporary restoration of the required depth of navigation were begun September 22, 1902, under the contract with Samuel O. Dixon, and completed October 4. The channel was dredged for a width of 60 feet to a depth of 17 feet below zero of gauge at the entrance and for a width of 60 feet to a depth of 15 feet inside. The dredged quantities measured 12,455 cubic yards.

A contract was entered into, under date of March 20, 1903, with Burk, Smith & Nelson for repairing the north pier between stations 0 and 0+45E and for refilling the pile piers on both sides of the channel. Work under this contract was begun May 22, and at the end of the fiscal year the repairs of the north pier between stations 0 and 0+45E were nearly completed, the old filling in the north pier between stations 0+45 and 15+15 had been overhauled as far down as 1 foot below water surface, and about 116 cords of new brush had been placed in the work between stations 7+20 and 15+15 and ballasted with 48 cords of old and 39 cords of new stone. In the south pier the old filling had been overhauled between stations 7+23 and the inner end, and about 222 cords new brush had been placed in the work between stations 7+90 and 18+51 and ballasted with 33 cords of old and about 159 cords of new stone.

## CONDITION OF WORKS JUNE 30, 1903.

The pier structures at Pentwater are practically as described in the Annual Report for 1900, page 3914, except that the filling in the pile work has settled greatly. Nine hundred and twelve feet of the north pier at its inner end will be rebuilt above water during the present season.

Soundings made at Pentwater June 1-2 showed an available depth outside on a line 50 feet south of the prolonged channel face of the north pier of 14.8 feet, on the shoalest section between the piers 100 feet inside of outer end of south pier 12.6 feet, and 14 feet in mid-channel from shore line to Pentwater Lake. The depths are referred

# 1964 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

to the level of zero of gauge. The stage of the lake at the time of soundings was -0.7 to -1.1 feet.

The works at White Lake will be in fair condition after the completion of the repairs now in progress, except 105 feet of crib work in the south pier, which is 20 years old, and will require a new superstructure before long.

Soundings made May 28-29 showed the following available depths referred to the level of zero of gauge: Outside of piers, 14.5 feet; in channel between piers 12 feet at outer end for a width of 70 feet next to south pier, with better water in middle of channel inside. The stage of the lake at the time of soundings was -0.8 to -1.1 feet.

## WORK PROPOSED FOR FISCAL YEAR ENDING JUNE 30, 1904.

The repair work contracted for at Pentwater, and that now under-way at White Lake will be completed. The channel at each harbor will be dredged for the temporary restoration of the required depth of navigation as soon as the dredges employed under the existing contract with the Lydon & Drews Company become available. Of the remaining funds \$500 for each harbor has been set apart as part payment of an inspection steamer, and the remaining balances will be applied to ordinary repairs and such additional dredging as may become necessary.

## ESTIMATE OF FUNDS FOR FISCAL YEAR ENDING JUNE 30, 1905.

At Pentwater the approved project provides for an extension to the south pier of 200 feet, at an estimated cost of \$22,000. The commerce of this harbor is of very slight importance, and would receive but little benefit from the above pier extension unaccompanied by thorough dredging. For the present, at least, no estimate is furnished, and maintenance alone is provided for. The estimate is:

Repairing and refilling piers .....	\$8,000
Dredging .....	8,000
<b>Total .....</b>	<b>16,000</b>

At White Lake, to complete the existing project, there remains to be done the extension of the north pier by 50 feet and of the south pier by 100 feet, at a total cost of \$18,100. This work would be of no immediate benefit to navigation, and for the present may be postponed especially since the commerce of this harbor is of slight importance. No estimate is therefore made for improvement, but the maintenance of the harbor so as to preserve its present capacity seems temporarily justifiable. The estimate is as follows:

Repairing and refilling piers .....	\$7,000
Dredging .....	8,000
<b>Total .....</b>	<b>15,000</b>

## Pentwater.

Total amount appropriated and allotted to June 30, 1903 .....	\$298,820.00
Total amount expended on project of 1867, amended in 1873, 1884, and 1892:	
For construction .....	\$179,873.15
For maintenance .....	97,749.12
	<b>277,622.27</b>
<b>Balance .....</b>	<b>16,197.73</b>
Original estimated cost, 1867, amended 1873, 1884, and 1892 .....	327,713.40

# APPENDIX O O—REPORT OF LIEUT. COL. M. B. ADAMS. 1965

## White Lake.

Total amount appropriated and allotted to June 30, 1903 .....	\$339,550.00
Total amount expended on project, 1866, amended in 1873, 1884, 1892, and 1898:	
For construction .....	\$207,862.44
For maintenance .....	120,282.68
	<u>328,145.12</u>
Balance .....	11,404.88
Original estimated cost, 1866, amended in 1873, 1884, 1892, and 1898...	353,550.00

## Money statement.

July 1, 1902, balance unexpended .....	36,034.06
June 30, 1903, amount expended during fiscal year .....	8,431.45
	<u>27,602.61</u>
July 1, 1903, balance unexpended .....	27,602.61
July 1, 1903, outstanding liabilities .....	120.00
	<u>27,482.61</u>
July 1, 1903, balance available .....	27,482.61
July 1, 1903, amount covered by uncompleted contracts .....	18,265.65
	<u>47,893.40</u>
(Amount (estimated) required for completion of existing project .....	47,893.40
Amount that can be profitably expended in fiscal year ending June 30, 1905, for maintenance of improvement, in addition to the balance unexpended July 1, 1903 .....	31,000.00
Submitted in compliance with requirements of sundry civil act of June 4, 1897, and of section 7 of the river and harbor act of 1899.	

## APPROPRIATIONS.

Date.	Pent- water.	White Lake.	Total.
March 2, 1867 .....	\$55,000	\$57,000	\$112,000
April 10, 1869 (allotment) .....	17,820	44,550	62,370
July 11, 1870 .....	10,000	20,000	30,000
March 3, 1871 .....	10,000	20,000	30,000
June 10, 1872 .....	30,000	10,000	40,000
March 3, 1873 .....	20,000	7,000	27,000
June 23, 1874 .....		10,000	10,000
March 3, 1875 .....		10,000	10,000
August 14, 1876 .....	10,000	5,000	15,000
June 18, 1878 .....	10,000	12,000	22,000
March 3, 1879 .....	6,000	7,500	13,500
June 14, 1880 .....	4,000	5,000	9,000
March 3, 1881 .....	10,000	7,500	17,500
August 2, 1882 .....	10,000	12,000	22,000
July 5, 1884 .....	15,000	10,000	25,000
August 5, 1886 .....	10,000	10,000	20,000
August 11, 1888 .....	8,000	10,000	18,000
September 19, 1890 .....	8,000	17,000	25,000
July 13, 1892 .....	5,000	5,000	10,000
August 18, 1894 .....	5,000	5,000	10,000
June 3, 1896 .....	5,000	5,000	10,000
March 3, 1899 .....	25,000	35,000	60,000
June 13, 1902 (allotments) .....	20,000	15,000	35,000
Total .....	298,820	339,550	638,370

## ABSTRACT OF CONTRACTS IN FORCE.

### HARBOR AT PENTWATER.

#### Emergency contract for dredging.

Contractor: Samuel O. Dixon.  
Date of contract: July 31, 1902.  
Date of beginning: August 6, 1902.  
Date of expiration: October 6, 1902; time limit waived.  
Rate: 20 cents per cubic yard.

1966 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

*Dredging.*

Contractor: The Lydon & Drews Company.  
Date of contract: March 26, 1903.  
Date of approval: May 6, 1903.  
Date of beginning: May 24, 1903.  
Date of expiration: October 9, 1903.  
Rate: 16½ cents per cubic yard.

*Repair of north pier.*

Contractor: Burk, Smith & Nelson.  
Date of contract: March 13, 1903.  
Date of approval: March 24, 1903.  
Date of beginning: August 1, 1903.  
Date of expiration: November 15, 1903.  
Rates: Cutting down and removing old work, \$2 per linear foot; white-oak piles, 40 cents per linear foot; white-oak timber, \$50 per M feet B. M.; white pine, long-leaf yellow pine or Douglas fir timber, \$32 per M feet B. M.; white pine or long-leaf yellow pine planks, \$30 per M feet B. M.; driftbolts, 3¼ cents per pound; screw bolts, tie-rods, and spikes, 4 cents per pound.

---

HARBOR AT WHITE LAKE.

*Emergency contract for dredging.*

Contractor: Samuel O. Dixon.  
Date of contract: July 31, 1902.  
Date of beginning: August 6, 1902.  
Date of expiration: October 6, 1902; time limit waived.  
Rate: 20 cents per cubic yard.

*Dredging.*

Contractor: The Lydon & Drews Company.  
Date of contract: March 26, 1903.  
Date of approval: May 6, 1903.  
Date of beginning: May 24, 1903.  
Date of expiration: October 9, 1903.  
Rate: 16½ cents per cubic yard.

*Repair of piers.*

Contractor: Burk, Smith & Nelson.  
Date of contract: March 20, 1903.  
Date of approval: April 8, 1903.  
Date of beginning: August 1, 1903.  
Date of expiration: November 15, 1903.  
Rates: Cutting down and removing old work, \$3 per linear foot; white-oak piles, \$1 per linear foot; white-oak timber, \$50 per M feet B. M.; white pine, long leaf yellow pine, or Douglas fir timber, \$34 per M feet B. M.; white pine or long leaf yellow pine planks for decking, \$30 per M feet B. M.; driftbolts, screw bolts, tie-rods, and spikes, 4 cents per pound; edgings or brush, \$4 per cord; stone, \$6.50 per cord.

---

O O 10.

IMPROVEMENT OF HARBOR AT LUDINGTON, MICHIGAN.

The history of this improvement is brought to the beginning of the fiscal year in Report of Chief of Engineers for 1902, pages 2168-2169.

OPERATIONS DURING FISCAL YEAR ENDING JUNE 30, 1903.

Soundings made July 1-3, 1902, showed an available depth of 18.9 feet below the level of zero of gauge in a narrow channel between the

piers, and on October 18 dredging was begun under the contract with Samuel O. Dixon for the restoration of the required navigable width of the channel. The shoal areas at and in front of the entrance were dredged to a depth of 21 feet below the level of zero of gauge, and those between the piers to a depth of 20 feet. The work was completed November 26, and resulted in affording a depth of 19 feet below zero of gauge for the full width between piers at the entrance and a depth of 18 feet for 120 feet width inside. The dredged quantities measured 24,804 cubic yards.

A continuing contract for the extension and repairs of the piers and revetments was entered into on November 8, 1902, with T. J. Bennett & Co. The contract stipulates that work for which funds are available shall be completed on or before December 31, 1903, and that all work provided for by each future appropriation shall be completed by the end of the calendar year in which the appropriation is made. The necessary funds having been made available by the sundry civil act of March 3, 1903, all the work under this contract is to be completed on or before December 31, 1903.

The work to be done is as follows: (1) Extending the north pier 400 feet by three cribs each 100 by 30 by 18½ feet, and one crib 100 by 30 by 22½ feet, and the south pier 100 feet by one crib 100 by 30 by 22½ feet, all cribs resting on a pile foundation and completed with a superstructure 6 feet high; (2) repairing the north revetment for a length of 588 feet between stations 0 and 5+88; (3) repairing the south revetment between stations 0 and 5+67; (4) repairing the north pier between stations 12+37 and 14+89; and (5) repairing the south pier between stations 11+73 and 16+79.5. Operations under this contract were begun April 13, and at the end of the fiscal year the following work had been done: (1a) Extension of the north pier: The construction of crib No. 1 was completed; the site of cribs 2 and 3 was dredged to the required depth; the 84 foundation piles for crib No. 1 and 47 of those for crib No. 2 were driven, and crib No. 1 was sunk in its place on June 22. (1b) Extension of the south pier: 20 courses of the new crib were constructed, the 84 foundation piles were driven, and the site of the crib was leveled up with 101 cords of stone. (2) Repairing the north revetment from station 0 to 5+88; 67 round piles were driven in the rear row between stations 5+88 and 0+57, and 124 round piles in the front row between stations 6+88 and 0+93. (3) Repairing the south revetment from station 0 to 5+67: The old superstructure and the filling above grade were removed, and the front piles sawed off between stations 5+67 and 0+62, and the rear piles between stations 5+67 and 0+90. The cap on the old rear piles was secured between stations 5+66.5 and 0+99.6, the cap on the old front piles between stations 5+66.5 and 0+63.3, and the guide for the sheet piles between stations 5+64.7 and 0+76.6. (4) Repairing the north pier between stations 12+37 and 14+89: The three upper courses of the front wall between stations 12+40 and 13+40 were removed.

#### CONDITION OF WORK JUNE 30, 1903.

This remains as reported in the Annual Report for 1901, page 3113, except for the added deterioration due to the past two years and the work done under the existing contracts. The car-ferry steamers of the Pere Marquette Railroad Company are large and unwieldy, and frequent slight damage is done by them to the channel walls of both piers. On December 25 the car ferry No. 18 damaged the east end of

# 1968 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

the north pier, and on February 18 the car ferry No. 16 ran into the north pier, about 200 feet from the outer end, breaking the timbers of the upper two to four courses for a length of about 60 feet.

The present condition of the channel was ascertained by soundings, made June 3-4, at a stage of the lake of 0.8 to 0.9 foot below the level of zero of gauge. The available depth at that time was: Outside, 20.6 feet; at end of piers, 22.3 feet; and in mid-channel between the piers, 20 feet, the depths being referred to zero of gauge.

## WORK PROPOSED FOR FISCAL YEAR ENDING JUNE 30, 1904.

After completion of the work now under contract with T. J. Bennett & Co. there will remain the further extension of the north pier by 300 feet and of the south pier by 200 feet, for the completion of all the work of pier construction provided for by the adopted project. It is intended, however, to await the results of the proposed extensive dredging with the new hydraulic dredge before deciding to further increase the length of the piers, and to devote the funds remaining available to dredging needed this season, under the contract with the Lydon & Drews Company, to part payment of the new hydraulic dredge and running expenses of the same while dredging during next season, and to such ordinary repairs of the piers and revetments as may become necessary.

## ESTIMATE OF FUNDS FOR FISCAL YEAR ENDING JUNE 30, 1905.

No immediate extension of the piers being in contemplation, the estimate is only for maintenance by dredging and repairs, the amount needed for this purpose being \$15,000.

Total amount appropriated and allotted to June 30, 1903.....	\$658,435.00
Less amount carried to surplus fund.....	.90
	<hr/> 658,434.10
Total amount expended on project, 1867, amended 1885, 1889, 1890, and 1899:	
For construction.....	\$334,175.75
For maintenance.....	84,738.62
	<hr/> 418,914.37
Balance.....	234,519.73
Original estimated cost of work, 1867, revised 1890.....	381,682.00
Estimated cost of modified project approved March 3, 1899.....	210,000.00

## Money statement.

July 1, 1902, balance unexpended.....	\$78,203.00
Amount appropriated by sundry civil act approved March 3, 1903.....	165,000.00
	<hr/> 243,203.00
June 30, 1903, amount expended during fiscal year.....	8,683.27
	<hr/> 234,519.73
July 1, 1903, balance unexpended.....	234,519.73
July 1, 1903, outstanding liabilities.....	442.50
	<hr/> 234,077.23
July 1, 1903, balance available.....	234,077.23
July 1, 1903, amount covered by uncompleted contracts.....	97,992.88
	<hr/> 136,084.35
{ Amount that can be profitably expended in fiscal year ending June 30, 1905, for maintenance of improvement, in addition to the balance unexpended July 1, 1903.....	15,000.00
{ Submitted in compliance with requirements of sundry civil act of June 4, 1897, and of section 7 of the river and harbor act of 1899.	

# APPENDIX O O—REPORT OF LIEUT. COL. M. B. ADAMS. 1969

## APPROPRIATIONS.

March 2, 1867 .....	\$50,000.00	August 5, 1886 .....	\$56,250.00
April 10, 1869 (allotment) ..	31,185.00	August 11, 1888 .....	60,000.00
July 11, 1870 .....	10,000.00	July 13, 1892 .....	5,000.00
March 3, 1871 .....	10,000.00	August 18, 1894 .....	6,000.00
June 10, 1872 .....	10,000.00	June 3, 1896 .....	25,000.00
March 3, 1873 .....	26,000.00	March 3, 1899 .....	25,000.00
June 23, 1874 .....	20,000.00	June 13, 1902 .....	75,000.00
March 3, 1875 .....	10,000.00	March 3, 1903 .....	165,000.00
August 14, 1876 .....	10,000.00		
June 18, 1878 .....	15,000.00	Total .....	653,435.00
March 3, 1879 .....	5,000.00	Amount carried to the sur-	
June 14, 1880 .....	8,000.00	plus fund, 1872 .....	.90
March 3, 1881 .....	10,000.00		
August 3, 1882 .....	12,000.00		653,434.10
July 5, 1884 .....	10,000.00		

## ABSTRACT OF CONTRACTS IN FORCE.

### *Emergency contract for dredging.*

Contractor: Samuel O. Dixon.  
Date of contract: July 31, 1902.  
Date of beginning: August 6, 1902.  
Date of expiration: October 6, 1902; time limit waived.  
Rate: 20 cents per cubic yard.

### *Dredging.*

Contractor: The Lydon & Drews Company.  
Date of contract: March 26, 1903.  
Date of approval: May 6, 1903.  
Date of beginning: May 24, 1903.  
Date of expiration: October 9, 1903.  
Rate: 16½ cents per cubic yard.

### *Extension and repair of piers.*

Contractor: T. J. Bennett & Co.  
Date of contract: November 8, 1902.  
Date of approval: November 28, 1902.  
Date of beginning: April 15, 1903.  
Date of expiration: December 31, 1903.  
Rates: Cutting down and removing old work, \$2.10 per linear foot; dredging, 50 cents per cubic yard; foundation piles, 60 cents per linear foot; white-oak piles, 33 cents per linear foot; white-oak timber, \$48 per M feet B. M.; white-pine timber, \$50.90 per M feet B. M.; hemlock timber, \$21 per M feet B. M.; long leaf yellow-pine plank for sheet piles, \$38 per M feet B. M.; white-pine plank for decking, \$28 per M feet B. M.; driftbolts and spikes, 8 cents per pound; screw bolts, 3½ cents per pound; carriage bolts, 4 cents per pound; tie-rods, 3½ cents per pound; stone, \$6.75 per cord; sand filling, 16 cents per cubic yard.

## COMMERCIAL STATISTICS FOR CALENDAR YEAR ENDING DECEMBER 31, 1902.

[Compiled from statement furnished by the deputy collector of customs at Ludington, Mich.]

Character of vessel.	Number.	Tonnage.
Steam .....	3,070	3,973,118
Sail .....	280	39,536
Total .....	3,350	4,012,653

Maximum draft, 18 feet.

# 1970 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

## *Receipts and shipments by vessel, 1902.*

Articles received.	Tons.	Articles shipped.	Tons.
Merchandise, miscellaneous.....	250,563	Merchandise, miscellaneous.....	223,390
Flour.....	74,238	Coal.....	175,740
Grain.....	86,000	Iron.....	238,467
Iron.....	15,047	Salt.....	53,000
Lumber.....	73,000	Lumber.....	48,000
Malt.....	6,194	Sugar.....	10,478
Meat.....	3,596	Hay.....	1,742
Potatoes.....	121	Wood ware.....	1,849
Copper.....	19,396	Bark.....	1,436
Feed.....	6,596	Flour.....	700
Wool.....	77	Potatoes.....	161
Sugar.....	280	Cement.....	1,285
Coal.....	280	Leather.....	251
		Fruit.....	775
Total.....	535,438	Total.....	806,274

	Tons
Total freight carried, 1902.....	1,341,712
Total freight carried, 1901.....	1,126,003
Increase.....	215,709

During the year the People's Transit Company put into service a steamer between Chicago and Ludington and other east-shore points, doing a general passenger and freight business.

## O O II.

### IMPROVEMENT OF HARBOR AT MANISTEE, MICHIGAN.

The history of this work to the beginning of the year is found in Report of Chief of Engineers for 1902, pages 2171-2172.

#### OPERATIONS DURING FISCAL YEAR ENDING JUNE 30, 1903.

A contract for extending the south pier 150 feet was entered into on November 14, 1902, with T. J. Bennett & Co., the work to be completed November 1, 1903. The extension is to consist of one crib 150 feet long, 30 feet wide, and 16½ feet high, surmounted by a superstructure 6 feet high. The crib is being built at Ludington, and six courses had been completed at the close of the fiscal year. When completed it is to be towed to Manistee and sunk in its place on a pile foundation. No other work has been done at the harbor during the fiscal year.

#### CONDITION OF WORKS JUNE 30, 1903.

The piers and revetments are in fair condition, except for some breaks in the north pier due to collisions and that the filling in many pockets has settled considerably. On April 30 the barge *F. W. Fletcher*, of Manistee, collided with the north pier near station 8+60, breaking three timbers of the front and one timber of the rear wall. On June 23 the steamer *F. & P. M. No. 4*, owned by the Manistee, Ludington and Milwaukee Transit Company, ran into the front wall of the north



# APPENDIX O O—REPORT OF LIEUT. COL. M. B. ADAMS. 1971

pier at station 28+08, breaking the two top timbers. The portion of the north revetment occupied by the Manistee and Northeastern Railroad Company, referred to in the Annual Report for 1899, page 2940, still remains without repairs.

The condition of the channel was ascertained by soundings made between April 27 and May 6 to be as follows: Available depth outside of piers 21 feet; in channel between piers 17 feet at outer end, 16.5 feet at shore line at a point 60 feet from north pier, and 15.2 feet near inner end of north revetment; in the river 14.1 feet in middle of channel on the shoalest cross section. The depths refer to the level of zero of gauge. The stage of the lake at the time of soundings was 0.9 to 1.4 feet below zero of gauge.

## WORK PROPOSED FOR FISCAL YEAR ENDING JUNE 30, 1904.

To complete the approved project requires the extension of the south pier by 250 feet, 150 feet of which will be built this year under the contract now in force. Of the available balance about \$3,000 will be applied this season to dredging under the contract with the Lydon & Drews Company for the restoration of the needed depth of navigation, \$1,000 will be reserved as allotment for the purchase of an inspection steamer, \$10,000 as allotment for the purchase of the hydraulic dredge, and the remainder for ordinary repairs and additional dredging.

## ESTIMATE OF FUNDS FOR FISCAL YEAR ENDING JUNE 30, 1905.

For the present it is not intended to recommend further pier extensions, and the estimate is therefore simply for maintenance by repairs and dredging, for which the amount of \$15,000 is asked.

Total amount appropriated and allotted to June 30, 1903 .....	\$437,000.00
Total amount expended on project 1866, amended 1871, 1875, 1890, 1892, 1898, and 1901:	
For construction .....	\$305,228.21
For maintenance .....	87,367.60
	<hr/> 392,595.81
Balance .....	44,404.19
	<hr/>
Original estimated cost of work, 1866, amended in 1871, 1875, 1890, 1892, 1898, and 1901 .....	428,000.00

## Money statement.

July 1, 1902, balance unexpended .....	\$45,844.13
June 30, 1903, amount expended during fiscal year .....	939.94
	<hr/>
July 1, 1903, balance unexpended .....	44,404.19
	<hr/>
July 1, 1903, amount covered by uncompleted contracts .....	16,037.76
	<hr/>
{ Amount that can be profitably expended in fiscal year ending June 30, 1905, for maintenance of improvement, in addition to the balance unexpended July 1, 1903. ....	15,000.00
{ Submitted in compliance with requirements of sundry civil act of June 4, 1897, and of section 7 of the river and harbor act of 1899. ....	

# 1972 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

## APPROPRIATIONS.

March 2, 1867 .....	\$60,000	August 2, 1882 .....	\$15,000
July 11, 1870 .....	20,000	July 5, 1884 .....	10,000
March 3, 1871 .....	9,000	August 5, 1886 .....	10,000
June 10, 1872 .....	10,000	August 11, 1888 .....	10,000
March 3, 1873 .....	10,000	September 19, 1890 .....	50,000
June 23, 1874 .....	10,000	July 13, 1892 .....	50,000
March 3, 1875 .....	25,000	August 18, 1894 .....	12,000
August 14, 1876 .....	14,000	June 3, 1896 .....	15,000
June 18, 1878 .....	15,000	March 3, 1899 .....	20,000
March 3, 1879 .....	10,000	June 13, 1902 .....	42,000
June 14, 1880 .....	10,000		
March 3, 1881 .....	10,000	Total .....	437,000

## ABSTRACT OF CONTRACTS IN FORCE.

### *Dredging.*

Contractor: The Lydon & Drews Company.  
 Date of contract: March 26, 1903; approved May 6, 1903.  
 Date of beginning: May 24, 1903.  
 Date of expiration: October 9, 1903.  
 Rate: 16½ cents per cubic yard.

### *Extension of south pier.*

Contractor: T. J. Bennett & Co.  
 Date of contract: November 14, 1902.  
 Date of approval: December 4, 1902.  
 Date of beginning: April 15, 1903.  
 Date of expiration: November 1, 1903.  
 Rate:

Dredging, 40 cents per cubic yard.  
 Foundation piles, 50 cents per linear foot.  
 White oak guard piles, 34 cents per linear foot.  
 White oak timber, \$48 per M feet B. M.  
 White pine timber, \$30.90 per M feet B. M.  
 Hemlock or Norway pine timber, \$21 per M feet B. M.  
 White pine plank, \$27 per M feet B. M.  
 Driftbolts, screw bolts, and spikes, 8 cents per pound.  
 Stone, \$6.25 per cord.

## COMMERCIAL STATISTICS FOR CALENDAR YEAR ENDING DECEMBER 31, 1902.

[Compiled from statement furnished by the deputy collector of customs at Manistee, Mich.]

Character of vessels.	Number.	Ton- nage.
Steam .....	1,532	535,296
Sail .....	662	132,662
Total .....	2,194	667,958

Maximum draft, 15 feet.

### *Receipts and shipments by vessel, 1902.*

Articles received.	Tons.	Articles shipped.	Tons.
Merchandise, miscellaneous .....	4,728	Merchandise, miscellaneous .....	3,969
Stone and gravel .....	6,449	Lumber .....	232,000
Oats .....	15	Shingles .....	2,800
Flour .....	10	Salt .....	522,738
Fruit .....	100	Wood, slabs, etc .....	17,000
Pine logs .....	2,200	Apples .....	50
		Fish .....	20,200
Total .....	13,502	Total .....	796,757

# APPENDIX O O—REPORT OF LIEUT. COL. M. B. ADAMS. 1973

	Tons.
Total freight carried in 1902.....	812,259
Total freight carried in 1901.....	634,979
Increase .....	177,280

New lines established during year: People's Transit Company, between Chicago, Manistee, and other east-shore points, doing a general passenger and package freight business.

## O O 12.

### HARBOR OF REFUGE AT PORTAGE LAKE, MINISTEE COUNTY, MICHIGAN.

The history of this improvement to the beginning of the year is found in Report of the Chief of Engineers for 1902, pages 2174, 2175.

#### OPERATIONS DURING FISCAL YEAR ENDING JUNE 30, 1903.

A contract was entered into May 26, 1903, with the Fitz Simons & Connell Company for dredging the channel to the projected depth of 18 feet at a stage of 2 feet below the level of zero of gauge. It is estimated that a channel of the stated depth and about 180 feet wide can be made with the funds available for this purpose. The contractors commenced operations on June 11, and at the end of the fiscal year they had made two cuts aggregating 1,700 feet in length and varying in depth from 14 to 19 feet, removing therefrom 24,404 cubic yards of sand. Owing to the high bank in front of the dredge it was not found practicable to make the cuts to the required depth at once, and the areas dredged will therefore have to be gone over a second time.

#### CONDITION OF WORK JUNE 30, 1903.

The north pier and revetment, including a wing 114 feet long at the inner end, consist of 1,349 feet of pile work and 851 feet of crib work, has a total length of 2,200 feet, and projects 1,230 feet beyond the shore line. The south pier and revetment, including a wing 17 feet long at the inner end, consist of 1,399 feet of pile work and 901 feet of crib work, has a total length of 2,300 feet, and projects 1,190 feet beyond the shore line. The works are in good condition, except 787 feet of pile work at the inner end of the south pier, which is to be repaired with sheet piles under a contract entered into April 17, 1903, with T. J. Bennett & Co. Operations under this contract are to be begun April 1, 1904, and to be completed October 1, 1904.

By soundings made May 8 the available depths referred to the level of zero of gauge were found to be 21 feet outside and 9.9 feet inside in a narrow channel close to the north pier, but this condition will be rapidly improved as the dredging now under way progresses.

#### WORK PROPOSED FOR FISCAL YEAR ENDING JUNE 30, 1904.

The dredging commenced in June, 1903, under the contract with The Fitz Simons & Connell Company will be completed, and operations on the repairs of the interior 787 feet of the south pier will be commenced under the contract with T. J. Bennett & Co. Of the balance of available funds \$500 is to be used in part payment of an inspection

# 1974 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

steamer, and what remains after providing for the payment of work under contract will be used as part payment of the new hydraulic dredge.

## ESTIMATE OF FUNDS FOR FISCAL YEAR ENDING JUNE 30, 1905.

With the repairs of the south pier now provided for, the work will be in excellent condition. For the proper maintenance of the channel now being made it will be necessary to reduce the high banks which will remain between it and the piers. This will require the removal of an estimated quantity of 100,000 cubic yards at a cost of \$15,000. The estimate for ordinary repairs is \$5,000, making the total estimate for maintenance \$20,000.

Total amount appropriated and allotted to June 30, 1903 .....	\$369,500.00
Total amount expended on project, 1879, amended in 1890, 1898, and 1899:	
For construction .....	\$217,807.62
For maintenance .....	94,091.77
	<u>311,899.39</u>
Balance .....	58,100.61
Original estimated cost of work, 1879, amended 1890, 1898, and 1899, \$344,300.	

## Money statement.

July 1, 1902, balance unexpended .....	\$59,484.96
June 30, 1903, amount expended during fiscal year .....	1,864.35
July 1, 1903, balance unexpended .....	58,100.61
July 1, 1903, outstanding liabilities .....	86.67
July 1, 1903, balance available .....	<u>58,013.94</u>
July 1, 1903, amount covered by uncompleted contracts .....	<u>44,608.35</u>
<div> <div> Amount that can be profitably expended in fiscal year ending June 30, 1905, for maintenance of improvement, in addition to the balance unexpended July 1, 1903 </div> <div> Submitted in compliance with requirements of sundry civil act of June 4, 1897, and of section 7 of the river and harbor act of 1899. </div> </div>	
	20,000.00

## APPROPRIATIONS.

March 3, 1879 .....	\$10,000	August 18, 1894 .....	\$25,000
June 14, 1880 .....	10,000	June 3, 1896 .....	25,000
March 3, 1881 .....	10,000	March 3, 1899 .....	75,000
August 2, 1882 .....	25,000	June 6, 1900 .....	85,000
July 5, 1884 .....	12,500	June 13, 1902 .....	59,000
August 5, 1886 .....	15,000		
August 11, 1888 .....	10,000	Total .....	<u>369,500</u>
September 19, 1890 .....	8,000		

## ABSTRACT OF CONTRACTS IN FORCE.

### Dredging.

Contractor: The Fitz Simons & Connell Company.  
Date of contract: April 23, 1903.  
Date of approval: May 26, 1903.  
Date of beginning: June 13, 1903.  
Date of expiration: December 1, 1903.  
Rate: 12½ cents per cubic yard.

*Repair of south pier.*

Contractor: T. J. Bennett & Co.

Date of contract: April 17, 1903.

Date of approval: May 13, 1903.

Date of beginning: Not earlier than April 1 nor later than May 1, 1904.

Date of expiration: Five months from date of beginning and not later than October 1, 1904.

Rates: Cutting down and removing old work, \$1 per linear foot; white-oak piles, 33 cents per linear foot; white-oak timber, \$45 per M feet B. M.; white pine, long leaf yellow pine, or Douglas fir timber, \$32 per M feet B. M.; white pine, long leaf yellow pine, or Douglas fir planks for sheet piles, \$40 per M feet B. M.; white pine or long leaf yellow pine planks for decking, \$30 per M feet B. M.; driftbolts, 3½ cents per pound; screw bolts, tie-rods, and spikes, 3½ cents per pound; carriage bolts, 4½ cents per pound.

## O O 13.

## IMPROVEMENT OF FRANKFORT HARBOR, MICHIGAN.

The history of this work to the beginning of the year is found in Report of the Chief of Engineers for 1902, page 2176.

## OPERATIONS DURING FISCAL YEAR ENDING JUNE 30, 1903.

The dredging plant of contractor Samuel O. Dixon began operations on September 16 for the reestablishment of the required width and depth of navigation and completed the same on October 9. The work resulted in restoring a depth of 19 feet below the level of zero of gauge for the full width of the channel at entrance and a depth of 18 feet for a width of 120 feet between the piers. The dredged quantity was 25,023 cubic yards.

A contract was entered into on April 17, 1903, with T. J. Bennett & Co. for extending the north pier 200 feet, for repairing the south pier between stations 10+84 and 12+87, and for removing the projecting 29 feet of the north pier at the east end. The projecting end of the north pier formed a sort of an impediment in the way of vessels about to make a landing at the dock of the Ann Arbor Railroad Company immediately north of it, and as it was not needed for the preservation of the channel its removal had been decided upon. Recently, however, the railroad company has rebuilt its dock in such a manner that its south end is flush with the existing end of the pier, and it has become desirable to retain the pier in its full length. A supplementary contract has therefore been concluded, annulling that part of the original contract relating to the removal of the end of the north pier. Operations under the contract were begun in May. The two cribs, each 100 by 24 by 18½ feet for the north pier extension, are being built at Ludington, and crib No. 1 has been completed and 16 courses of crib No. 2. The 64 foundation piles for crib No. 1 and 37 of those for crib No. 2 have been driven. For the repairs of the south pier between stations 10+84 and 12+87, the removal of the old superstructure between stations 10+84 and 11+17 has been completed, and partly of that from stations 11+17 to 12+87, and the first course of the new superstructure has been built from stations 10+82 to 11+46.7 in the

# 1976 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

front and to stations 12+08.7 in the rear wall, and the second course to stations 11+14.7 in both walls.

## CONDITION OF WORK ON JUNE 30, 1903.

This is practically as described in Annual Report for 1901, page 3123, except that the piers were run into and damaged on several occasions by the car ferries of the Ann Arbor Railroad Company. Such damage is of constant occurrence, and in the past it has been customary for the railroad company to make the necessary repairs at its own expense. The inner end of the south pier is practically ruined for about 60 or 70 feet in consequence of such collisions, and the United States Life-Saving Establishment has built a wall of sheet piles behind this part of the pier for the protection of the bank.

Soundings made June 8-9 showed the following depths, referred to the level of zero of gauge: Outside, 19.8 feet; in mid-channel at end of south pier, 19.6 feet, but only 18.5 feet 140 feet north of south pier; in mid-channel between piers 19.8 feet. The stage of the lake at the time of soundings was 1 to 1.1 feet below zero of gauge.

## WORK PROPOSED FOR FISCAL YEAR ENDING JUNE 30, 1904.

The work under the existing contract for the extension of the north pier and for the repairs of part of the south pier will be completed. As soon as a dredge becomes available under the contract with the Lydon & Drews Company, the channel at entrance and between the piers will be redredged for the restoration of the required width of the navigation. Of the remaining balance, \$10,000 will be applied as part payment of the new hydraulic dredge, and the remainder will be reserved for additional dredging and incidental repairs and refilling of the piers.

## ESTIMATE OF FUNDS FOR FISCAL YEAR ENDING JUNE 30, 1905.

After the completion of the pier extension now under contract the adopted project requires a further addition of 100 feet to each pier. It is intended, however, to await the result of the proposed extensive dredging with the new hydraulic dredge before recommending further pier extension, and the estimate is therefore confined to the amount needed for maintenance. This is as follows:

Dredging .....	\$10,000
Pier repairs and refilling .....	10,000
Total .....	20,000
Total amount appropriated and allotted to June 30, 1903 .....	\$438,159.85
Less amount covered into Treasury .....	5,721.50
	432,438.35
Total amount expended on project of 1866, amended in 1868, 1879, 1892, 1898, and 1899:	
For construction .....	\$291,206.99
For maintenance .....	91,914.30
	383,121.29
Balance .....	49,317.06
Original estimated cost of work, 1866, amended 1868, 1879, 1892, 1898, and 1899 .....	421,938.35

# APPENDIX O O—REPORT OF LIEUT. COL. M. B. ADAMS. 1977

## Money statement.

July 1, 1902, balance unexpended .....	\$55,909.94
June 30, 1903, amount expended during fiscal year .....	6,592.88
July 1, 1903, balance unexpended .....	49,317.06
July 1, 1903, outstanding liabilities .....	186.67
July 1, 1903, balance available .....	49,130.39
July 1, 1903, amount covered by uncompleted contracts .....	26,056.32
<hr/>	
{ Amount that can be profitably expended in fiscal year ending June 30, 1905, for maintenance of improvement, in addition to the balance unexpended July 1, 1903 .....	
{ Submitted in compliance with requirements of sundry civil act of June 4, 1897, and of section 7 of the river and harbor act of 1899. ....	
	20,000.00

## APPROPRIATIONS.

<b>Aux Becs Scies, Michigan:</b>		<b>Frankfort, Mich.:</b>	
June 23, 1866 .....	\$88,541.00	August 2, 1882 .....	\$15,000.00
March 2, 1867 .....	10,000.00	July 5, 1884 .....	5,000.00
July 25, 1868 (allotment) .....	10,000.00	August 5, 1886 .....	7,000.00
April 10, 1869 (allotment) .....	29,318.85	August 11, 1888 .....	8,000.00
July 11, 1870 .....	10,000.00	September 19, 1890 .....	10,000.00
March 3, 1871 .....	10,000.00	July 13, 1892 .....	10,000.00
<b>Frankfort, Mich.:</b>		August 18, 1894 .....	50,000.00
June 10, 1872 .....	10,000.00	June 3, 1896 .....	15,000.00
March 3, 1873 .....	10,000.00	March 3, 1899 .....	35,000.00
June 23, 1874 .....	10,000.00	June 13, 1902 .....	54,500.00
March 3, 1875 .....	10,000.00	Total .....	438,159.85
August 14, 1876 .....	3,000.00	Amount covered into the	
June 18, 1878 .....	8,800.00	Treasury (Report, 1871, p.	
March 3, 1879 .....	4,000.00	133) .....	5,721.50
June 14, 1880 .....	5,000.00		
March 3, 1881 .....	10,000.00		432,438.35

## ABSTRACT OF CONTRACTS IN FORCE.

### Emergency contract for dredging.

Contractor: Samuel O. Dixon.  
Date of contract: July 31, 1902.  
Date of beginning: August 6, 1902.  
Date of expiration: October 6, 1902; time limit waived.  
Rate: 20 cents per cubic yard.

### Dredging.

Contractor: The Lydon & Drews Company.  
Date of contract: March 26, 1903.  
Date of approval: May 6, 1903.  
Date of beginning: May 24, 1903.  
Date of expiration: October 9, 1903.  
Rate: 16½ cents per cubic yard.

### Extension and repair of piers.

Contractor: T. J. Bennett & Co.  
Date of contract: April 17, 1903.  
Date of approval: May 13, 1903.

# 1978 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

Date of beginning: May 15, 1903.

Date of expiration: September 15, 1903.

Rates: Dredging, 60 cents per cubic yard; cutting down and removing old work, \$2 per linear foot; white-oak piles, 35 cents per linear foot; foundation piles, 60 cents per linear foot; white-oak timber, \$45 per 1,000 feet B. M.; white-pine, long-leaf yellow pine, or Douglas fir timber, \$32 per 1,000 feet B. M.; hemlock or Norway pine timber, \$22.50 per 1,000 feet B. M.; white-pine or long-leaf yellow-pine planks, \$30 per 1,000 feet B. M.; driftbolts, screw bolts, and spikes, 3½ cents per pound; stone, \$6.20 per cord. Removing the projecting east end of north pier, lump sum of \$100 (this last item annulled by supplemental contract dated May 21, 1903).

## COMMERCIAL STATISTICS FOR CALENDAR YEAR ENDING DECEMBER 31, 1902.

[Compiled from statement furnished by the deputy collector of customs at Frankfort, Mich.]

Character of vessel.	Number.	Tonnage.
Steam .....	1,560	1,998,093
Sail .....	282	34,540
Total .....	1,842	2,020,573

Maximum draft, 18 feet.

### Receipts and shipments by vessel, 1902.

Articles received.	Tons.	Articles shipped.	Tons.
Farm products .....	58	Lumber .....	27,000
Freight cars, loaded .....	453,145	Freight cars, loaded .....	459,830
Freight cars, empty .....	1,175	Freight cars, empty .....	3,495
		Wood, bark, etc .....	3,300
		Shingles .....	224
		Fruit .....	25
		Miscellaneous .....	400
Total .....	454,373	Total .....	494,274

	Tons.
Total freight carried in 1902 .....	948,647
Total freight carried in 1901 .....	774,981
Increase .....	173,666

New lines established during year: People's Transit Company between Chicago, Frankfort, and other east-shore points, doing a general passenger and package freight business.

O O 14.

## IMPROVEMENT OF HARBOR AT CHARLEVOIX, MICHIGAN.

The history of this work to the beginning of the year is found in the Report of the Chief of Engineers for 1902, pages 2178-2179.

### OPERATIONS DURING FISCAL YEAR ENDING JUNE 30, 1903.

Under the provisions of the river and harbor act of June 13, 1902, to obtain a uniform depth of channel from Lake Michigan to Pine Lake, the upper channel was dredged between August 6 and 29, under the contract with Samuel O. Dixon, for a width of 50 feet to a depth



# APPENDIX O O—REPORT OF LIEUT. COL. M. B. ADAMS. 1979

of 19 feet below the level of zero of gauge; 30,370 cubic yards was the quantity of material removed.

## CONDITION OF WORK JUNE 30, 1903.

This is as described in the Annual Report for 1901, page 3126, but a contract has been entered into with Archibald J. Beauvais for repairing the crib work between stations 14+22.7 and 17+25.4 in the north pier and between stations 15+26.6 and 17+77.9 in the south pier of the lower channel, and the north revetment of the upper channel. The date of the contract is March 26, 1903, and the work is to be begun August 1 and to be completed November 15, 1903.

Soundings made June 11-15 showed an available depth of 15.8 to 16.4 feet at the outer end of the piers, and 16.2 feet between the piers of the lower channel, and 18 feet in the upper channel. The soundings are reduced to the level of zero of gauge. The stage of the lake at the time of soundings was 1 to 1.2 feet below zero of gauge.

## WORK PROPOSED FOR FISCAL YEAR ENDING JUNE 30, 1904.

The work of repairing parts of the piers of the lower channel and the north revetment of the upper channel under the contract now in force will be begun and completed. About \$2,000 will be expended for dredging for the restoration of the required depth in the lower channel under the contract with the Lydon & Drews Company. The remaining balance will be reserved for incidental repairs or for such additional dredging as may become necessary.

## ESTIMATE OF FUNDS FOR FISCAL YEAR ENDING JUNE 30, 1905.

About 600 feet of the north revetment need complete reconstruction, the south revetment of the upper channel should be rebuilt above the water surface, and all the structures require considerable filling. The approved project provides for an extension of 200 feet to the south pier, at an estimated cost of \$19,800. The estimate is therefore as follows:

To complete the project: Two hundred feet extension to south pier, at \$99. \$19,800  
For maintenance:

Rebuilding about 600 feet north revetment (lower channel).....	15,000
Rebuilding superstructure south revetment (upper channel).....	4,000
Miscellaneous small repairs and refilling .....	4,000
Dredging.....	5,000

Total..... 47,800

As provided by section 14 of the river and harbor act of June 13, 1902, and in pursuance of the directions of the Chief of Engineers dated June 23, 1902, a special report was submitted to the Chief of Engineers under date of October 3, 1902, upon a preliminary examination of Charlevoix Harbor, Michigan, "with a view to obtaining a channel 18 feet in depth from Lake Michigan to Pine Lake."

Total amount appropriated and allotted to June 30, 1903.....\$175,500.00

Total amount expended on project of 1868, amended in 1876 and 1884:

For construction.....	\$80,205.04
For maintenance .....	81,857.40
	<hr/> 162,062.44

Balance..... 13,437.56  
Original estimated cost 1868, amended 1876 and 1884..... 184,000.00

# 1980 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

## Money statement.

July 1, 1902, balance unexpended .....	\$21, 131. 19
June 30, 1903, amount expended during fiscal year .....	7, 693. 63
July 1, 1903, balance unexpended .....	13, 437. 56
July 1, 1903, amount covered by uncompleted contracts .....	10, 965. 02
(Amount (estimated) required for completion of existing project ....	19, 800. 00
Amount that can be profitably expended in fiscal year ending June 30, 1905, in addition to the balance unexpended July 1, 1903:	
For works of improvement .....	\$19, 800. 00
For maintenance of improvement .....	28, 000. 00
	47, 800. 00
Submitted in compliance with requirements of sundry civil act of June 4, 1897, and of section 7 of the river and harbor act of 1899.	

## APPROPRIATIONS.

August 14, 1876 .....	\$10, 000.	September 19, 1890 .....	\$9, 000
June 18, 1878 .....	12, 000	July 13, 1892 .....	10, 000
March 3, 1879 .....	9, 000	August 18, 1894 .....	8, 000
June 14, 1880 .....	10, 000	June 3, 1896 .....	20, 000
March 3, 1881 .....	10, 000	March 3, 1899 .....	15, 000
August 2, 1882 .....	10, 000	June 13, 1902 .....	20, 000
July 5, 1884 .....	10, 000		
August 5, 1886 .....	10, 000	Total .....	175, 500
August 11, 1888 .....	12, 500		

## ABSTRACT OF CONTRACTS IN FORCE.

### Emergency contract for dredging.

Contractor: Samuel O. Dixon.  
Date of contract: July 31, 1902.  
Date of beginning: August 6, 1902.  
Date of expiration: October 6, 1902; time limit waived.  
Rate: 20 cents per cubic yard.

### Dredging.

Contractor: The Lydon & Drews Company.  
Date of contract: March 26, 1903.  
Date of approval: May 6, 1903.  
Date of beginning: May 24, 1903.  
Date of expiration: October 9, 1903.  
Rate: 16½ cents per cubic yard.

### Repair of piers and revetment.

Contractor: Archibald J. Beauvais.  
Date of contract: March 26, 1903.  
Date of approval: April 13, 1903.  
Date of beginning: August 1, 1903.  
Date of expiration: November 15, 1903.  
Rates: Cutting down and removing old work, \$2 per linear foot; white oak timber, \$50 per M feet, B. M.; white pine, long-leaf yellow pine, or Douglas fir timber, \$32 per M feet, B. M.; white pine or long-leaf yellow pine planks, \$30 per M feet, B. M.; driftbolts and screw bolts, 3¼ cents per pound; spikes, 4 cents per pound; stone, \$6 per cord; edgings, \$2.50 per cord.

# APPENDIX O O—REPORT OF LIEUT. COL. M. B. ADAMS. 1981

## COMMERCIAL STATISTICS FOR CALENDAR YEAR ENDING DECEMBER 31, 1902.

[Compiled from statement furnished by the deputy collector of customs at Charlevoix, Mich.]

Character of vessels.	Number.	Tonnage.
Steam .....	688	247, 274
Sail .....	444	92, 326
Total .....	1, 132	339, 600

Maximum draft, 16.3 feet.

### Receipts and shipments by vessel, 1902.

Articles received.	Tons.	Articles shipped.	Tons.
Lumber .....	218	Lumber, shingles, etc .....	229, 116
Coal .....	6, 025	Coal .....	2, 100
Beer .....	50	Apples and potatoes .....	1, 119
Hay .....	500	Merchandise, miscellaneous .....	1, 600
Grain .....	4, 770		
Flour .....	160		
Bran .....	24		
Merchandise, miscellaneous .....	286		
Total .....	12, 042	Total .....	233, 935

	Tons.
Total freight carried in 1902 .....	245, 977
Total freight carried in 1901 .....	190, 156
Increase .....	55, 821

## O O 15.

### IMPROVEMENT OF HARBOR AT PETOSKEY, MICHIGAN.

The previous history of this improvement is carried to the beginning of the year in the report of the Chief of Engineers for 1902, pages 2180, 2181.

No work was done at this harbor during the past year and the condition of the works remain substantially as described upon page 3129 of the Annual Report for 1901.

### WORK PROPOSED FOR FISCAL YEAR ENDING JUNE 30, 1904.

The balance of previous appropriations now available is about \$17,000. The river and harbor act of June 13, 1902, contains the following provision:

Improving harbor at Petoskey, Michigan: Continuing improvement and for maintenance, \$15,000, and the Secretary of War is hereby authorized to change or modify existing plans: *Provided*, That the total of expenditure shall not exceed the amount estimated to complete under the existing project.

The total amount available is therefore \$32,000. Previous investigation has shown that the north breakwater, which is 200 feet long, is too near the city wharf and that the entrance between the breakwater is too narrow.

Bids were accordingly invited by public advertisement for the

# 1982 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

removal of the north breakwater, and the extension of the west breakwater by the two cribs to be removed from the north breakwater and by one new crib 100 feet long and 30 feet wide on a stone foundation. The bids were opened June 24, and that of the lowest bidder, A. J. Beauvais & Co., has been accepted. The work under the contract to be entered into is to begin prior to May 1, 1904, and to be completed November 1, 1904. Six hundred dollars of the remaining balance is to be applied as part payment for the purchase of an inspection steamer and the rest reserved for contingencies.

## ESTIMATE OF FUNDS FOR FISCAL YEAR ENDING JUNE 30, 1905.

An early extension of the west breakwater will unquestionably prove necessary after its extension and the removal of the north breakwater. An estimate is therefore furnished for an extension of 200 feet and also for the necessary maintenance, viz:

200 feet extension of west breakwater, at \$150.....	\$30,000
Repairs .....	3,000
Total.....	33,000
Total amount appropriated to June 30, 1903.....	\$88,000.00
Total amount expended on project 1894:	
For construction.....	\$53,156.65
For maintenance .....	2,378.68
	55,535.33
Balance .....	32,464.67
Original estimated cost of work, approved August 18, 1894 .....	170,000.00

### Money statement.

July 1, 1902, balance unexpended.....	\$32,636.77
June 30, 1903, amount expended during fiscal year.....	172.10
July 1, 1903, balance unexpended.....	32,464.67
July 1, 1903, outstanding liabilities.....	40.00
July 1, 1903, balance available .....	32,424.67
(Amount (estimated) required for completion of existing project.....	82,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1905, in addition to the balance unexpended July 1, 1903:	
For works of improvement.....	\$30,000.00
For maintenance of improvement .....	3,000.00
	33,000.00
Submitted in compliance with requirements of sundry civil act of June 4, 1897, and of section 7 of the river and harbor act of 1899.	

### APPROPRIATIONS.

September 19, 1890.....	\$15,000	March 3, 1899.....	\$20,000
July 13, 1892.....	20,000	June 13, 1902 .....	15,000
August 18, 1894.....	10,000		
June 3, 1896 .....	8,000	Total.....	88,000

## APPENDIX P P.

---

### IMPROVEMENT OF RIVERS AND HARBORS ON THE EASTERN COAST OF MICHIGAN.

---

*REPORT OF MAJ. LANSING H. BEACH, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1903, WITH OTHER DOCUMENTS RELATING TO THE WORKS.*

#### IMPROVEMENTS.

- |  |  |
|--|--|
| 1. Cheboygan Harbor, Michigan.                           | 6. Mouth of Black River, Rouge River, and Monroe Harbor, Michigan. |
| 2. Alpena Harbor (Thunder Bay River), Michigan.          | 7. Black River at Port Huron, Michigan.                            |
| 3. Saginaw River, Michigan.                              | 8. Pine River, Michigan.   |
| 4. Sebawaing River, Michigan.                            | 9. Belle River, Michigan.  |
| 5. Harbor of refuge at Sand Beach, Lake Huron, Michigan. | 10. Clinton River, Michigan.                                       |
- 

UNITED STATES ENGINEER OFFICE,  
*Detroit, Mich., July 18, 1903.*

GENERAL: I have the honor to transmit herewith the annual reports for the works of river and harbor improvement in my charge for the fiscal year ending June 30, 1903.

Very respectfully,

LANSING H. BEACH,  
*Major, Corps of Engineers.*

Brig. Gen. G. L. GILLESPIE,  
*Chief of Engineers, U. S. A.*

---

#### P P I.

#### IMPROVEMENT OF CHEBOYGAN HARBOR, MICHIGAN.

The work of dredging in this harbor was commenced May 1, 1903, by the contractors, Edward Brothers, of Sault Ste. Marie, Mich., and was stopped June 26, 1903. The dredging was done for a distance of

# 1984 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

1,400 feet, the upper end being just above Baker's warehouse, extending throughout the entire width of the river. The material excavated was clay, mill refuse, and soft mud which had deposited since the former work upon the harbor. Owing to the lowering of the level of Lake Huron, the dredging was required to go 1 foot deeper than formerly in order to maintain the depth required by the project. Considerable shoaling has occurred between Baker's wharf and the State Road Bridge. For this reason the aggregate for maintenance has increased slightly over the amount requested last year.

Original estimated cost of dredging and pier construction, 1871.....\$395,000.00  
Whole amount expended to June 30, 1903.....173,239.11

## Money statement.

July 1, 1902, balance unexpended.....	\$10,409.96
June 30, 1903, amount expended during fiscal year.....	7,649.07
July 1, 1903, balance unexpended.....	2,760.89
July 1, 1903, outstanding liabilities.....	289.39
July 1, 1903, balance available.....	2,471.50
(Amount (estimated) required for completion of existing project.....	5,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1905, in addition to the balance unexpended July 1, 1903:	
For works of improvement.....	\$5,000.00
For maintenance of improvement.....	4,000.00
	9,000.00
Submitted in compliance with requirements of sundry civil act of June 4, 1897, and of section 7 of the river and harbor act of 1899.	

## APPROPRIATIONS.

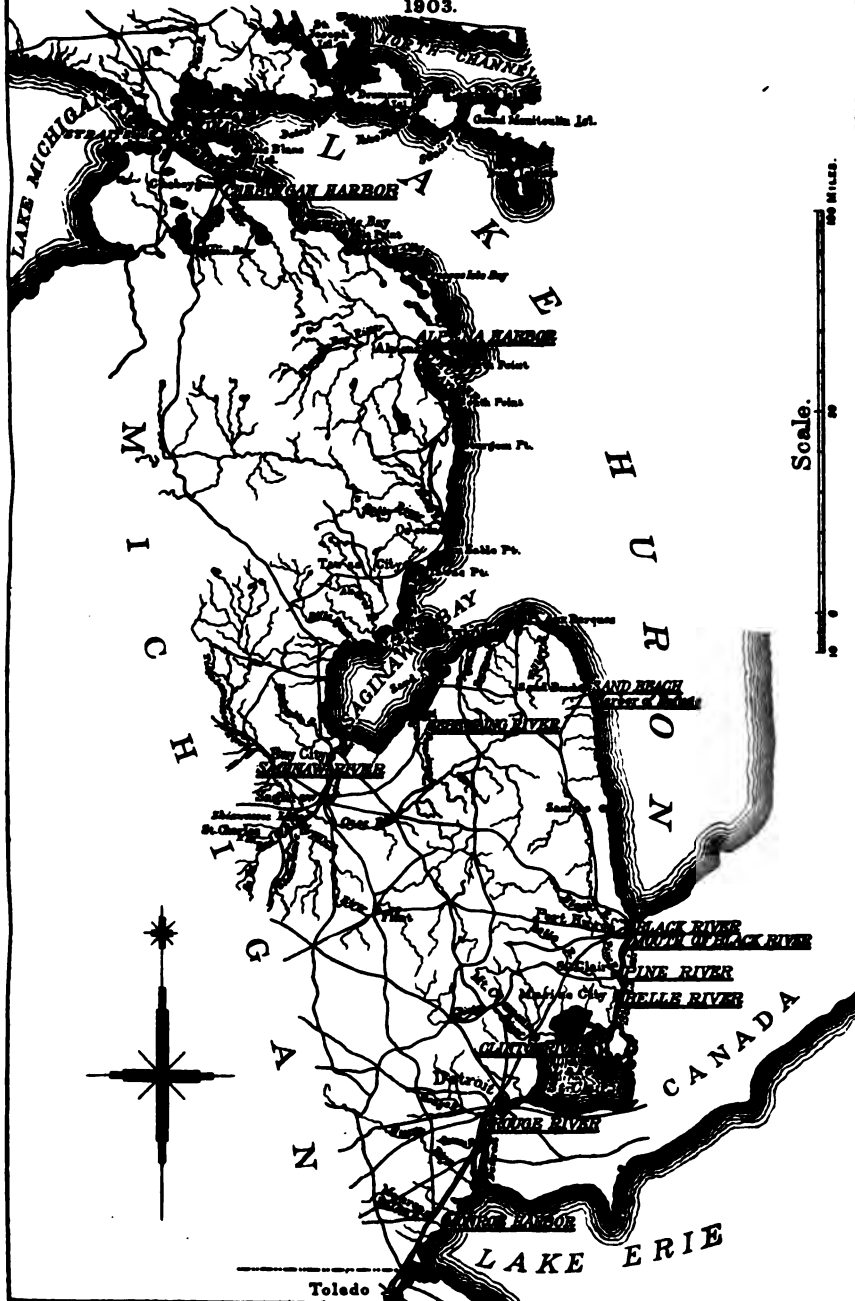
March 3, 1871.....	\$10,000	August 2, 1882.....	\$10,000
June 10, 1872.....	15,000	July 5, 1884.....	5,000
March 3, 1873.....	15,000	August 5, 1886.....	15,000
June 23, 1874.....	15,000	August 11, 1888.....	15,000
March 3, 1875.....	15,000	June 3, 1896.....	12,000
August 14, 1876.....	10,000	March 3, 1899.....	8,000
June 18, 1878.....	8,000	June 13, 1902.....	8,000
March 3, 1879.....	3,000		
June 14, 1880.....	6,000	Total.....	176,000
March 3, 1881.....	6,000		

## CONTRACT IN FORCE.

Contract in force with Edward Brothers, of Sault Ste. Marie, Mich., at 24 cents per cubic yard, scow measure, approved January 30, 1905. Date of beginning work, May 1, 1903; date of completion, June 26, 1903.

# RIVER AND HARBOR DISTRICT

IN CHARGE OF  
U.S. ENGINEER OFFICE, DETROIT, MICH.  
Major LANSING H. BEACH, Corps of Engineers U.S.A.  
1903.

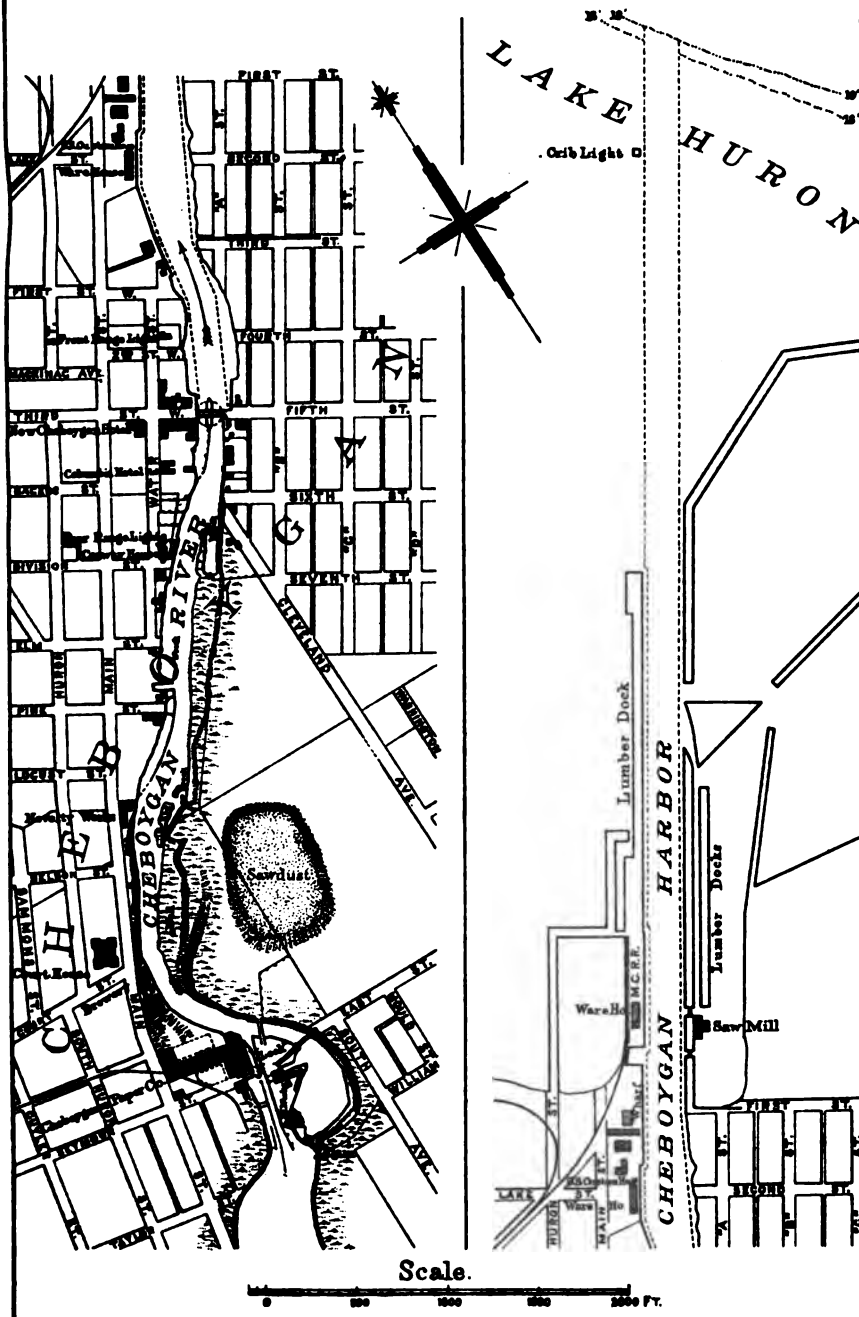


ANDREW S. GRADY, PHOTO-LITH. WASHINGTON, D.C.





# CHEBOYGAN HARBOR, MICH. 1903



ARCHD. B. BRAMAN PHOTO-LITHO. WASHINGTON, D.C.





# THUNDER BAY RIVER, MICH. 1903

Scale.

0 500 1000 1500 2000 Ft.



ANDREW S. GRAHAM PHOTO-LITHO WASHINGTON D.C.

## APPENDIX P P—REPORT OF MAJOR BEACH.

1985

## COMMERCIAL STATISTICS.

*Receipts and shipments by vessel for the calendar year ended December 31, 1902.*

[Compiled from statements furnished by Mr. C. L. Marquette, deputy collector of customs, Cheboygan, Mich.]

Articles.	Received.	Shipped.	Articles.	Received.	Shipped.
	Tons.	Tons.		Tons.	Tons.
Brick .....	500	125	Machinery .....	325	.....
Cedar posts .....	.....	6,700	Merchandise, general .....	18,696	2,181
Cedar ties .....	.....	28,481	Salt .....	35	.....
Coal .....	5,538	880	Shingles .....	.....	2,115
Farm products, miscella- neous .....	.....	408	Stone .....	1,906	.....
Fish .....	.....	200	Tan bark .....	.....	1,385
Flour .....	.....	140	Telegraph poles .....	.....	6,675
Grain .....	1,887	.....	Tar .....	.....	50
Gravel .....	.....	.....	Pulp wood .....	.....	550
Hay and Feed .....	95	501	Spiles .....	.....	141
Lath .....	.....	2,203	Sugar .....	.....	150
Leather .....	.....	100	Boom logs .....	.....	250
Lime .....	154	.....	Cement .....	3,155	250
Live stock .....	41	.....	Floats .....	.....	50
Logs .....	144,900	107,100	Wood .....	.....	37
Lumber .....	.....	102,152	Total .....	177,231	222,553

## P P 2.

IMPROVEMENT OF ALPENA HARBOR (THUNDER BAY RIVER),  
MICHIGAN.

No work was necessary during the past year. Past experience justifies the expectation that the improved channel will deteriorate very slowly and that no expenditure for maintenance or restoration is likely to be needed in the near future. The large area of impounded water above the dam seems to serve as a settling basin, and but little sediment appears to be carried into the portion of the channel already dredged. For this reason it is not considered necessary to submit an estimate for further appropriation at present.

Original estimate of cost, 1876, 1881, and 1889 (aggregate) ..... \$55,851.48  
 Whole amount expended to June 30, 1903 ..... 49,674.07

*Money statement.*

July 1, 1902, balance unexpended ..... \$2,325.98  
 June 30, 1903, amount expended during fiscal year ..... 500.00  
 July 1, 1903, balance unexpended ..... 1,825.98

## APPROPRIATIONS.

Thunder Bay Harbor, Michigan:	Alpena Harbor, Michigan:
August 14, 1876..... \$4,500	August 18, 1894..... \$4,000
August 2, 1882..... 15,000	June 3, 1896..... 2,500
September 19, 1890..... 5,500	
Thunder Bay River, Michigan:	Total..... 51,500
September 19, 1890..... 10,000	
July 13, 1892..... 10,000	

# 1986 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

## COMMERCIAL STATISTICS.

*Receipts and shipments by vessel for the calender year ended December 31, 1902.*

[Compiled from statements furnished by the deputy collector of customs, Alpena, Mich.]

Articles.	Received.	Shipped.	Articles.	Received.	Shipped.
	<i>Tons.</i>	<i>Tons.</i>		<i>Tons.</i>	<i>Tons.</i>
Brick .....	1,473		Lath .....		598
Cedar posts .....		13,087	Lime and cement .....		8,549
Cedar ties .....		42,782	Live stock .....	26	
Coal .....	40,801		Lumber .....		127,170
Farm products, miscella- neous .....	720		Machinery .....	400	200
Fish .....		690	Merchandise, general .....	11,710	4,066
Flour .....	840		Paper .....	2	240
Fruit, miscellaneous .....	450		Salt .....	791	
Grain .....	2,075		Shingles .....		844
Hay and feed .....	925		Total .....	60,213	193,201

## P P 3.

### IMPROVEMENT OF SAGINAW, FLINT, SHIAWASSEE, AND BAD RIVERS, MICHIGAN.

At the close of the fiscal year 1903 dredging was in progress under contract with Messrs. G. H. Breymann & Bros., of Toledo, Ohio. It is expected under this contract to improve the river from its mouth to Saginaw City, so as to provide a narrow channel of the depth contemplated in the project.

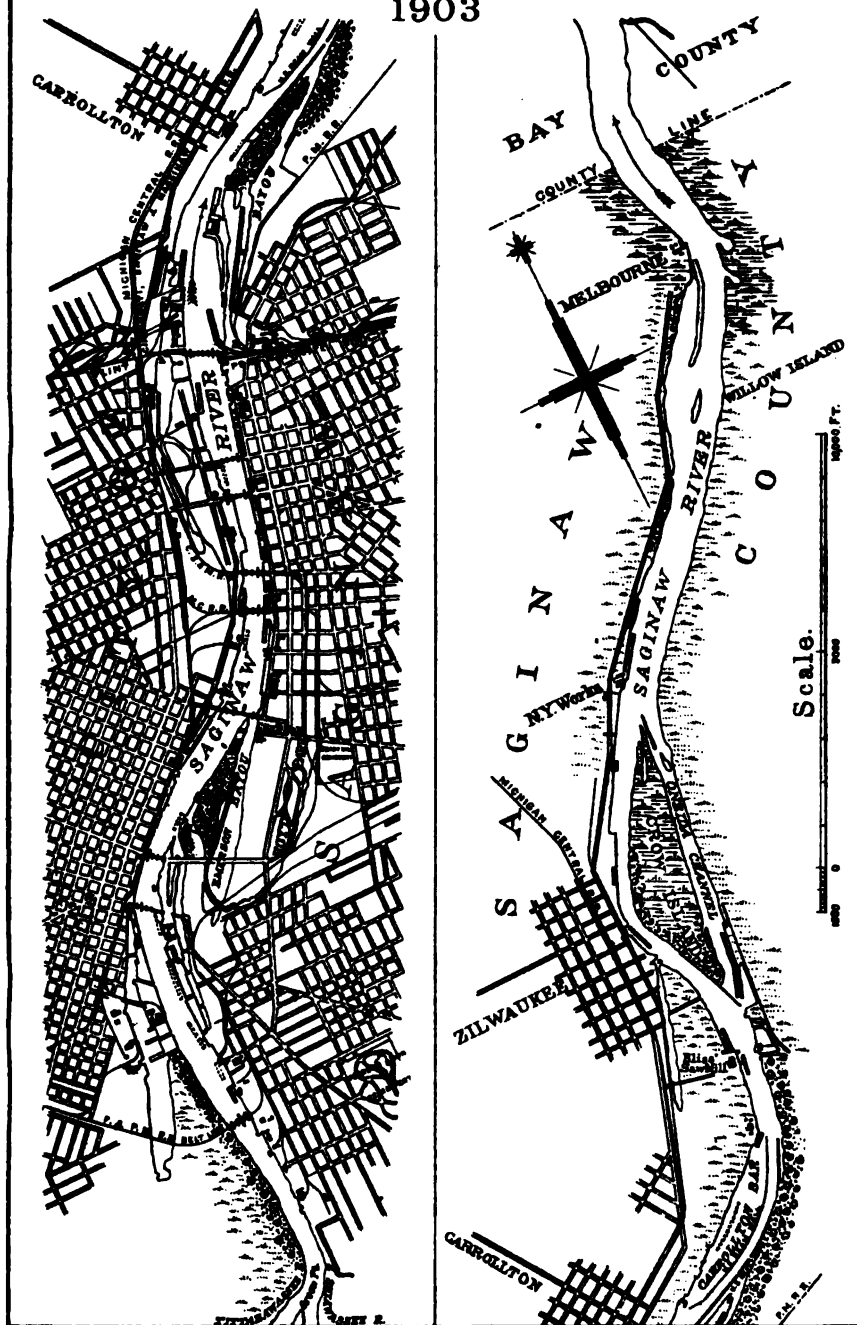
An examination was made by the officer in charge of the Flint, Shiawassee, and Bad rivers in November, 1902, but no steps were taken to expend any money upon these streams, as the conditions then existing did not seem to warrant it.

Estimated cost of successive projects, 1867 to 1882 .....	\$289,795.00
Estimated cost of project for 1882 .....	446,000.00
Total .....	735,795.00
Carried to surplus fund .....	1,000.00
Whole amount expended to June 30, 1903 .....	775,685.22

### *Money statement.*

July 1, 1902, balance unexpended .....	\$65,964.87
June 30, 1903, amount expended during fiscal year .....	3,900.09
July 1, 1903, balance unexpended .....	62,064.78
July 1, 1903, outstanding liabilities .....	5,042.87
July 1, 1903, balance available .....	57,021.91
July 1, 1903, amount covered by uncompleted contracts .....	17,467.13
Amount that can be profitably expended in fiscal year ending June 30, 1905, in addition to the balance unexpended July 1, 1903:	
For works of improvement .....	\$40,000.00
For maintenance of improvement .....	10,000.00
	50,000.00
Submitted in compliance with requirements of sundry civil act of June 4, 1897, and of section 7 of the river and harbor act of 1899.	

# SAGINAW RIVER, MICH. IN SAGINAW COUNTY. 1903



ANDREW S. GRAHAM, PHOTO-LITHO, WASHINGTON, D.C.





[illegible]

ANDREW B. GRAMAM, PHOTO-LITHO WASHINGTON, D.C.



## APPROPRIATIONS.

June 23, 1866 .....	\$67,500	August 5, 1886 .....	\$33,750
March 2, 1867 .....	28,000	August 11, 1888 .....	65,000
July 25, 1868 (allotment) .....	9,000	September 19, 1890 .....	75,000
July 11, 1870 .....	1,500	July 13, 1892 .....	100,000
June 23, 1874 .....	15,000	August 18, 1894 .....	40,000
March 3, 1875 .....	30,000	June 3, 1896 .....	40,000
August 14, 1876 .....	11,000	March 3, 1899 .....	40,000
June 18, 1878 .....	25,000	June 13, 1902 .....	50,000
March 3, 1879 .....	8,000		
June 14, 1880 .....	15,000	Total .....	888,750
March 3, 1881 .....	10,000	Carried to surplus fund .....	1,000
August 2, 1882 .....	125,000		
July 5, 1884 .....	50,000	Balance .....	837,750

## CONTRACT IN FORCE.

Contract in force with Messrs. G. H. Breymann & Bros., of Toledo, Ohio, for dredging, approved January 30, 1903, at 20 cents per cubic yard, scow measurement, for dredging bar at mouth, 16 cents per cubic yard in Bay County, and 21 cents per cubic yard in Saginaw County. Work was commenced in Bay County June 8, 1903.

## COMMERCIAL STATISTICS.

*Receipts and shipments by vessel for the calendar year ended December 31, 1902.*

[Compiled from statements furnished by Deputy Collectors C. M. Stewart, of Saginaw, Mich., and D. C. Brawn, of Bay City, Mich.]

Articles.	Received.	Shipped.	Articles.	Received.	Shipped.
	Tons.	Tons.		Tons.	Tons.
Booms .....		1,880	Live stock .....	800	250
Brick .....	35,000	3,015	Logs .....	126,045	44,310
Cedar posts .....	30,272		Lumber .....	532,122	8,641
Cedar ties .....	99		Machinery .....	50,000	15,000
Coal .....	10,486	25,081	Merchandise, general .....	736	2,211
Farm products .....	60	750	Paper .....	500	200
Fish .....	1,502	25	Pickets .....	1,504	
Fish packages .....		6	Salt .....	70	2,570
Flour .....	30	400	Stone .....	5,141	
Fruit, miscellaneous .....	75	15	Sugar-beet seeds .....	70	
Grain .....	200,000	2,000	Tan bark .....	500	
Gravel .....	200,008		Telegraph poles .....	1,750	
Hay and feed .....	300		Tea .....	186	
Iron and ore .....	1,000		Wood .....	420	
Lath .....	6,892				
Lime and cement .....	110	55	Total .....	1,012,620	106,409
Limestone .....	6,886				

## P P 4.

## IMPROVEMENT OF SEBEWAING RIVER, MICHIGAN.

At the beginning of the fiscal year the work of dredging the channel contemplated by the project under contract with Campbell Brothers, of Sault Ste. Marie, Mich., was still in progress, the time for completion of the contract having been waived December 4, 1901, for a reasonable period. The contractors had two dredges at work July 1, 1902, and these dredges continued operations until compelled to stop by ice on November 14, 1902.

The season was very unfavorable on Saginaw Bay, the roughness of the water interfering greatly with the progress of the work. Owing

1988 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

to the very shoal depths it was frequently impossible to tow the scows to the dumping grounds on account of the danger to them and the tug of striking bottom.

The material excavated varied from soft mud and sand, which had deposited in the trench and which it was necessary to remove in order to provide an exit for the dump scows, to the hardest kind of hardpan, which almost resembled rock in its consistency, ordinary dippers making practically no impression upon it.

Work was resumed with one dredge by Campbell Brothers April 17, 1903, and was prosecuted steadily to the close of the fiscal year. The result has been a trench in Saginaw Bay 75 feet wide and about 3 miles long from the mouth of the river. Owing to the fact that the cut in the bay is at right angles to the littoral drift there is a constant tendency to fill, this filling being sufficiently rapid to destroy the channel in a very few years. The use of dykes or training walls would not be effective, as the volume of discharge from the river is insufficient to produce the necessary scour and currents in the bay are too variable to be utilized. The river is unable to maintain a channel of more than 5 feet between its banks. Constant dredging will therefore be the only means of maintaining the work.

As a result of the redredging that has been necessary the available funds will be insufficient to provide the channel contemplated by the project and \$15,000 are estimated as necessary to increase the channel width from 75 feet now obtained to 100 feet. To this should be added \$4,000 for redredging in the river, which has shoaled to such an extent as to practically exclude vessels, and from which about 20,000 cubic yards should be removed to provide a channel 8 feet deep. The amount which will be necessary for annual maintenance can best be stated after a year or two of further experience.

The total amount of material excavated under the contract with Campbell Brothers up to June 30, 1903, was 179,341 cubic yards.

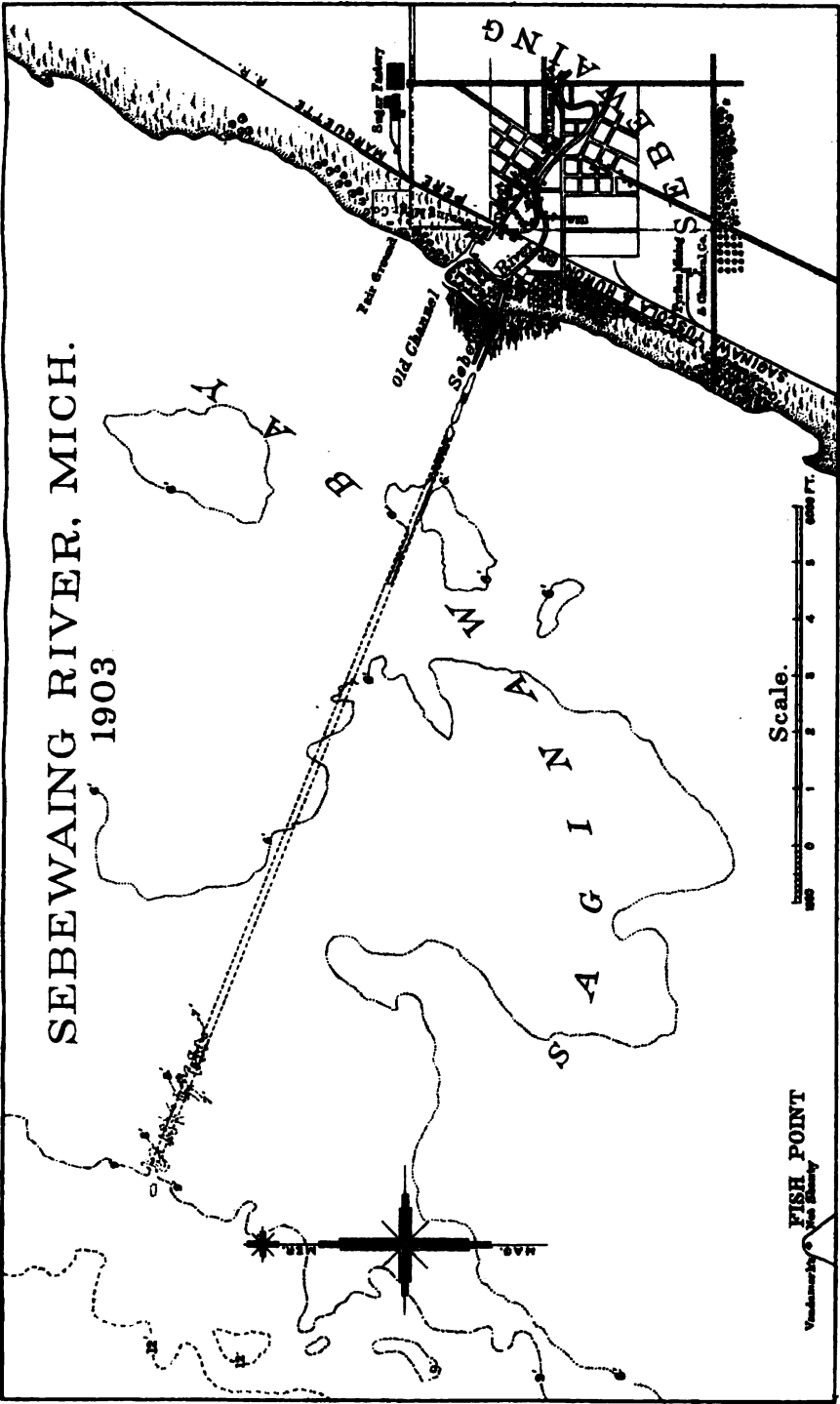
Original estimated cost of work, 1895.....	\$37,000.00
Whole amount expended on the present project to June 30, 1903.....	29,046.19

*Money statement.*

July 1, 1902, balance unexpended.....	20,414.54
June 30, 1903, amount expended during fiscal year.....	12,460.78
July 1, 1903, balance unexpended.....	7,953.81
July 1, 1903, outstanding liabilities.....	952.42
July 1, 1903, balance available.....	7,001.39
July 1, 1903, amount covered by uncompleted contracts.....	7,001.39
{ Amount (estimated) required for completion of existing project.....	15,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1905, for maintenance of improvement, in addition to the balance unexpended July 1, 1903.....	10,000.00
{ Submitted in compliance with requirements of sundry civil act of June 4, 1897, and of section 7 of the river and harbor act of 1899.	

APPROPRIATIONS.

March 3, 1875 (river and harbor).....	\$8,000
June 14, 1880.....	7,000
June 3, 1896.....	5,000
March 3, 1899.....	32,000
Total.....	52,000





## CONTRACT IN FORCE.

Contract in force with Campbell Brothers for dredging Sebewaing River, Michigan, approved September 13, 1899; date of beginning work, October 14, 1899; date of expiration, September 30, 1900. Extended to December 31, 1900, and to December 1, 1901. Time for completion waived for a reasonable period December 4, 1901.

## COMMERCIAL STATISTICS.

*Receipts and shipments, by vessel, for the calendar year ended December 31, 1903.*

[Compiled from statements furnished by Messrs. John C. Liken & Co., Sebewaing, Mich.]

Articles.	Received.	Shipped.	Articles.	Received.	Shipped.
	<i>Tons.</i>	<i>Tons.</i>		<i>Tons.</i>	<i>Tons.</i>
Brick .....	8,000	800	Live stock .....		600
Coal .....	2,500	17,000	Lumber .....	8,500	
Farm products, miscellaneous .....		22,000	Machinery .....	800	
Fish .....		250	Merchandise, general .....	1,000	100
Flour .....	150	600	Salt .....	150	
Fruit, miscellaneous .....	50	150	Shingles .....	1,800	
Grain .....	1,200	250	Stone .....	15,000	
Hay and feed .....		2,000	Unclassified freight .....	3,000	1,500
Lath .....	1,650		Total .....	88,500	44,750
Lime and cement .....	200				

## P P 5.

## IMPROVEMENT OF HARBOR OF REFUGE AT SAND BEACH, LAKE HURON, MICHIGAN.

The plans for the improvement of the harbor were completed, and at the close of the fiscal year 1903 work was under advertisement for bids for rebuilding so much of the superstructure as available funds would permit.

In addition to the permanent superstructure already authorized, the harbor should be otherwise improved in order to be equal to the present demands made upon it. The number as well as size of vessels has so increased since its establishment that the facilities which were ample a few years ago are now inadequate to enable all vessels which would like to do so to avail themselves of its advantages. The work which should be done to make the harbor fully adequate to present conditions is as follows:

(1) *Widening the entrance.*—This is at present but 600 feet wide, facing directly east, and has been found to be rather narrow in heavy seas with north, northeast, or southeast winds, and vessels with barges in tow frequently hesitate to make the attempt, and sometimes find it impossible to enter. This entrance should be widened to 800 feet, and should be deepened by dredging to a depth of at least 23 feet, so as to avoid any danger of vessels striking the bottom in a heavy sea. The cost of widening the present entrance to 800 feet is estimated as follows: 133,000 cubic yards of rock excavation, \$66,500; removing 200 feet of breakwater and rebuilding the end, \$9,000; total, \$75,500.

(2) *Construction of an interior pier (along line A, accompanying map).*—Owing to the fact that the bottom of the harbor is bed rock,

# 1990 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

it affords no anchorage whatever for vessels, and they are compelled during a storm to tie up to the main pier. This in times of heavy northeast storms causes great discomfort owing to the water and spray thrown over the breakwater and carried by the wind to some distance in the harbor. It also requires vessels to lie against each other owing to lack of space, and there have been occasions when the vessels have had to lie five deep. During a heavy southwest wind the waves raised in the harbor itself are sufficient to cause boats to bump badly against the pier. For the purpose of affording more pier space and also to permit vessels to lie in the harbor in more comfort, it is recommended that a pier be constructed along line A, as shown on the map. In addition to providing greater comfort in northeast and southwest storms, it will, it is believed, tend also to prevent the deposit of mud in the harbor. It is believed that the work of dredging the harbor, widening and deepening the entrance, and providing a permanent superstructure upon the present breakwaters is of greater importance than the building of proposed interior pier, and should be first executed. All plans and work in the harbor, however, should be made with the construction of this pier in view, and if the pier is authorized, it is believed much of its construction may be accomplished as an incident to the other work.

The sum of \$300,000 should be appropriated for improving the harbor during the coming year, of which amount about \$100,000 would be applied to widening and deepening the entrance and dredging in the interior of the harbor, and \$200,000 to continuing the work of constructing permanent superstructure. Owing to the present high prices of labor and materials, a continuing contract to be made at this time is not recommended.

The name "Sand Beach" was given to the locality before the establishment of any harbor owing to the existence of a small patch of sand along the shore, which along this rocky coast was sufficiently distinctive to be used by mariners as a landmark. Since the construction of the harbor it is no longer so used. The name of the town, railroad station, and the post-office have been changed to "Harbor Beach," which is more in accordance with existing conditions, and it is recommended that this term be hereafter used for the improvement instead of Sand Beach.

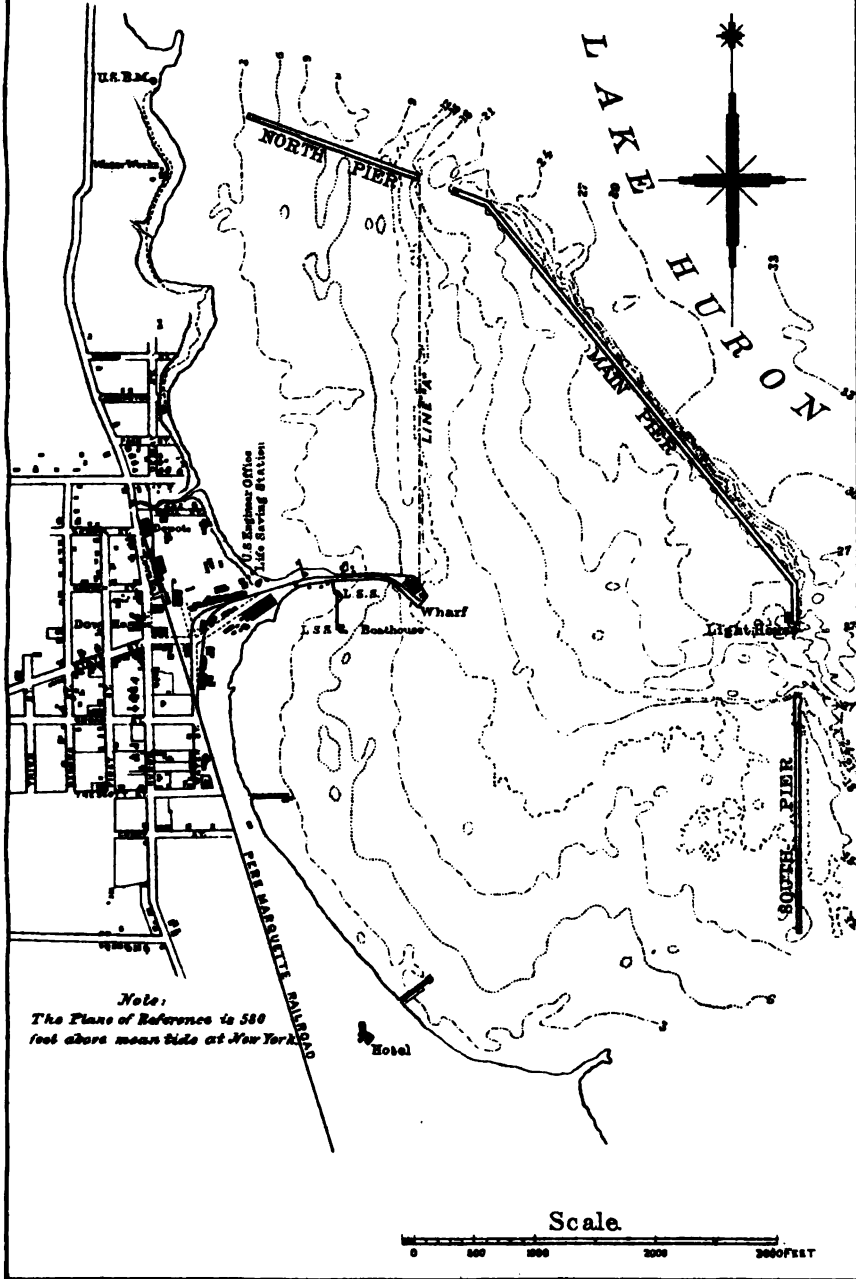
Original estimated cost of the work .....	\$1,442,500.00
Amount carried to surplus fund .....	30,000.00
Whole amount expended to June 30, 1903 .....	1,240,465.14

## Money statement.

July 1, 1902, balance unexpended .....	\$286,037.80
June 30, 1903, amount expended during fiscal year .....	12,695.11
July 1, 1903, balance unexpended .....	273,342.69
July 1, 1903, outstanding liabilities .....	477.14
July 1, 1903, balance available .....	272,865.55
{ Amount (estimated) required for continuation of project .....	300,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1905, in addition to the balance unexpended July 1, 1903:	
{     For works of improvement .....	\$300,000.00
{     For maintenance of improvement .....	10,000.00
{ .....	310,000.00
{ Submitted in compliance with the requirements of sundry civil act of June 4, 1897, and of section 7 of the river and harbor act of 1899.	



# HARBOR OF REFUGE, SAND BEACH, MICH. 1903



ANDREW S. GRAHAM, PHOTO-LITHO, WASHINGTON, D.C.



## APPROPRIATIONS.

March 3, 1871 .....	\$100,000.00	June 6, 1900 .....	\$150,000.00
June 10, 1872 .....	100,000.00	June 13, 1902 .....	7,500.00
March 3, 1873 .....	75,000.00		
June 23, 1874 .....	75,000.00	Total .....	1,548,500.00
March 3, 1875 .....	100,000.00	Carried to surplus fund ..	80,000.00
August 14, 1876 .....	75,000.00		
June 18, 1878 .....	100,000.00		1,513,500.00
March 3, 1879 .....	75,000.00	September 4, 1897, amount	
June 14, 1880 .....	75,000.00	collected on account of	
March 3, 1881 .....	50,000.00	damage to piers and de-	
August 2, 1882 .....	75,000.00	posited to credit of ap-	
July 5, 1884 .....	75,000.00	propriation .....	\$107.05
August 5, 1886 .....	75,000.00	March 10, 1902, amount	
August 11, 1888 .....	70,000.00	collected on account of	
September 19, 1890 .....	30,000.00	damage to piers and de-	
July 13, 1892 .....	150,000.00	posited to credit of ap-	
August 18, 1894 .....	20,000.00	propriation .....	200.78
June 3, 1896 .....	16,000.00		
March 3, 1899 .....	50,000.00	Total .....	1,513,807.88

TABLE 1.—Summary of vessels sheltered in the harbor of refuge at Sand Beach, Michigan, from July 1, 1902, to June 30, 1903, and the direction of wind at time of entering the harbor.

Direction of wind at time of entering.	1902.						1903.				
	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	Total.
North:											
Steam.....	11	17	22	36	5	0	0	9	4	6	110
Sail.....	1	1	2	9	1	0	1	0	0	0	15
Tows.....	8	2	8	18	3	0	0	0	0	0	32
Total.....	15	20	32	61	9	0	1	9	4	6	157
Northwest:											
Steam.....	16	46	13	34	8	10	0	8	11	32	178
Sail.....	0	1	1	3	1	1	0	1	0	3	11
Tows.....	1	7	5	12	1	0	0	0	3	7	36
Total.....	17	54	19	49	10	11	0	9	14	42	225
West:											
Steam.....	25	7	31	36	19	1	0	3	1	10	133
Sail.....	7	4	4	4	1	0	0	1	0	2	23
Tows.....	0	0	7	15	7	0	0	0	0	6	35
Total.....	32	11	42	55	27	1	0	4	1	18	191
Southwest:											
Steam.....	17	7	25	38	39	5	0	6	5	9	151
Sail.....	6	1	7	12	4	0	0	1	1	3	35
Tows.....	0	4	5	24	10	0	0	0	0	2	45
Total.....	23	12	37	74	53	5	0	7	6	14	231
South:											
Steam.....	7	7	6	7	20	0	0	0	12	4	63
Sail.....	2	1	0	3	4	0	0	1	2	0	13
Tows.....	0	0	0	2	5	0	0	0	2	0	9
Total.....	9	8	6	12	29	0	0	1	16	4	85
Southeast:											
Steam.....	13	15	39	15	10	4	1	6	13	6	122
Sail.....	1	10	3	1	1	0	0	1	2	1	20
Tows.....	0	0	4	6	0	0	0	0	0	0	10
Total.....	14	25	46	22	11	4	1	7	15	7	152
East:											
Steam.....	0	4	3	7	0	1	0	9	1	4	29
Sail.....	3	2	0	2	0	0	0	0	0	1	8
Tows.....	0	0	3	5	0	0	0	0	0	0	8
Total.....	3	6	6	14	0	1	0	9	1	5	45

# 1992 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

TABLE 1.—Summary of vessels sheltered in the harbor of refuge at Sand Beach, Michigan, from July 1, 1902, to June 30, 1903, etc.—Continued.

Direction of wind at time of entering.	1902.						1903.				
	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	Total.
Northeast:											
Steam.....	38	15	15	12	10	4	0	9	20	23	141
Sail.....	0	2	0	0	1	0	0	1	1	9	14
Tows.....	9	1	1	1	6	0	0	6	1	4	29
Total.....	42	18	16	13	17	4	0	16	22	36	184
Total each month:											
Steam.....	122	118	154	185	111	25	1	50	67	94	927
Sail.....	20	22	17	34	13	1	1	6	6	19	139
Tows.....	13	14	33	81	82	0	0	6	6	19	304
Total.....	155	154	204	300	156	26	2	62	79	132	1,270

TABLE 2.—Classified table of tonnage, by months, sheltered in the harbor of refuge at Sand Beach, from July 1, 1902, to June 30, 1903.

Date.	Steam.		Sail.		Tows.		Total.	
	Number.	Ton-nage.	Number.	Ton-nage.	Number.	Ton-nage.	Number.	Ton-nage.
1902.								
July.....	122	90,119	20	2,466	13	5,986	155	107,573
August.....	118	91,132	22	2,961	14	4,736	154	98,829
September.....	154	119,731	17	2,621	26	16,999	204	139,351
October.....	185	145,743	34	5,533	81	48,680	300	200,006
November.....	111	87,522	13	2,191	82	17,440	156	107,154
December.....	25	22,223	1	131	0	0	26	23,414
1903.								
March.....	1	48	1	89	0	0	2	137
April.....	50	28,110	6	841	6	2,321	62	31,772
May.....	67	50,145	6	938	6	2,636	79	53,719
June.....	94	81,926	19	2,375	19	12,714	132	97,015
Total.....	927	725,759	139	20,199	304	112,071	1,270	858,029

TABLE 3.—Number and tonnage of vessels sheltered in the harbor of refuge at Sand Beach, Michigan, 1877 to 1902, inclusive.

Calendar year.	Steam.	Sail.	Tow.	Total.	Total vessels.	Average tonnage.
	Tons.	Tons.	Tons.	Tons.		
1877.....	63,966	27,699	50,954	142,610	496	289
1878.....	104,035	59,699	99,232	263,006	781	311
1879.....	153,080	45,750	100,036	278,866	921	306
1880.....	153,720	55,630	147,297	356,610	1,317	275
1881.....	144,645	55,960	127,855	328,460	1,178	279
1882.....	146,133	26,504	114,067	282,703	1,022	280
1883.....	177,122	32,713	114,091	323,926	1,139	284
1884.....	156,513	34,724	122,980	314,222	1,142	275
1885.....	196,364	29,426	151,607	377,397	1,158	326
1886.....	196,835	33,797	140,632	370,267	1,304	284
1887.....	271,327	33,689	153,087	458,103	1,447	317
1888.....	271,917	39,756	202,191	513,864	1,624	316
1889.....	237,719	37,322	165,896	433,937	1,512	326
1890.....	325,362	38,326	189,104	553,782	1,575	339
1891.....	296,917	27,076	171,067	495,060	1,341	366
1892.....	362,486	29,465	162,605	554,556	1,441	365
1893.....	243,451	20,897	113,915	378,263	982	386
1894.....	321,511	22,961	134,064	478,536	1,150	416
1895.....	356,532	26,898	167,327	550,757	1,304	451
1896.....	246,447	24,621	105,968	377,037	1,073	351
1897.....	304,460	21,151	157,776	483,387	1,305	398
1898.....	505,630	18,090	107,176	630,900	1,304	535
1899.....	530,547	20,354	81,143	632,044	1,254	544
1900.....	617,161	20,919	124,924	763,004	1,306	603
1901.....	744,154	16,841	151,023	912,018	1,388	662
1902.....	747,179	21,871	124,139	893,189	1,349	662
Total.....	7,970,195	803,642	3,480,459	12,254,296	31,418	389



**BLACK RIVER, MICH.**  
1903

Michigan Sulphite Fibre Works  
GRAND TRUNK RAILWAY  
The James Building Co.  
Kern Brewing Co.

PORT  
BLACK RIVER  
ST. CLAIR RIVER

Scale.  
0 200 400 600 800 FEET

## P P 6.

IMPROVEMENT OF MOUTH OF BLACK RIVER, ROUGE RIVER, AND  
MONROE HARBOR, MICHIGAN.

## (a) MOUTH OF BLACK RIVER.

No work was in progress at this locality during the past fiscal year.

Original estimated cost (1871) of removing middle ground to depth of—	
15 feet .....	\$67,320.00
18 feet .....	157,520.00
Whole amount expended to June 30, 1903 .....	93,879.88

*Money statement.*

July 1, 1902, balance unexpended .....	\$5,870.12
June 30, 1903, amount expended during fiscal year .....	250.00
July 1, 1903, balance unexpended .....	5,620.12

## APPROPRIATIONS.

Mouth of Black River, in St. Clair River, Michigan:		Mouth of Black River, Michi- gan—Continued:	
June 10, 1872 .....	\$15,000	September 19, 1890 .....	\$10,000
St. Clair River, at Mouth of Black River, Michigan:		July 13, 1892 .....	10,000
March 8, 1873 .....	15,000	August 18, 1894 .....	4,000
June 28, 1874 .....	15,000	June 8, 1896 .....	4,000
March 8, 1875 .....	10,000	March 3, 1899 .....	4,000
June 18, 1878 .....	1,500	June 18, 1902 (allotment) ..	1,000
Mouth of Black River, Michigan:		Total .....	99,500
August 11, 1888 .....	10,000		

## (b) ROUGE RIVER.

Work of dredging this river began June 11, 1903, and at the close of the fiscal year was still in progress. But \$5,000 was available under allotment from appropriation made by the river and harbor act of June 13, 1902, and it was not sufficient to do more than remove some bars which had formed in the upper river and to restore the project depth to the lower river, where general shoaling had taken place. Permanent improvement of the channel is not believed possible, and the river will require periodical dredging for maintenance. An annual amount of \$5,000 should be provided for the purpose.

The establishment of the Detroit Iron and Steel Company's large plant near the mouth of the river makes it desirable to bring the largest vessels navigating the lakes into the river, and it is therefore recommended that the project be amended so as to provide a depth of 21 feet from the mouth of the river to the first bridge across the same, the project remaining as before for the portion of the river above this bridge.

Original estimated cost of the work, 1887 .....	\$31,690.89
Whole amount expended to June 30, 1903 .....	47,078.69

# 1994 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

## Money statement.

July 1, 1902, balance unexpended.....	\$5,049.59
June 30, 1903, amount expended during fiscal year.....	438.28
July 1, 1903, balance unexpended.....	4,611.31
July 1, 1903, outstanding liabilities.....	2,725.21
July 1, 1903, balance available.....	1,886.10
July 1, 1903, amount covered by uncompleted contracts.....	1,774.79
Amount (estimated) required for completion of existing project.....	28,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1905, in addition to the balance unexpended July 1, 1903:	
For works of improvement.....	\$5,000.00
For maintenance of improvement.....	5,000.00
	10,000.00
Submitted in compliance with requirements of sundry civil act of June 4, 1897, and of section 7 of the river and harbor act of 1899.	

## APPROPRIATIONS.

August 11, 1888.....	\$10,000
September 19, 1890.....	10,000
July 13, 1892.....	11,690
August 18, 1894.....	5,000
June 3, 1896.....	5,000
March 3, 1899 (transferred from appropriation for constructing turning basin in Rouge River, Michigan).....	5,000
Total.....	46,690
June 13, 1902 (allotment).....	5,000
Total.....	51,690

## CONTRACT IN FORCE.

Contract in force with Messrs. G. H. Breyman & Bros., of Toledo, Ohio, at 11 cents per cubic yard, scow measurement, approved January 30, 1903. Date of beginning work, June 11, 1903.

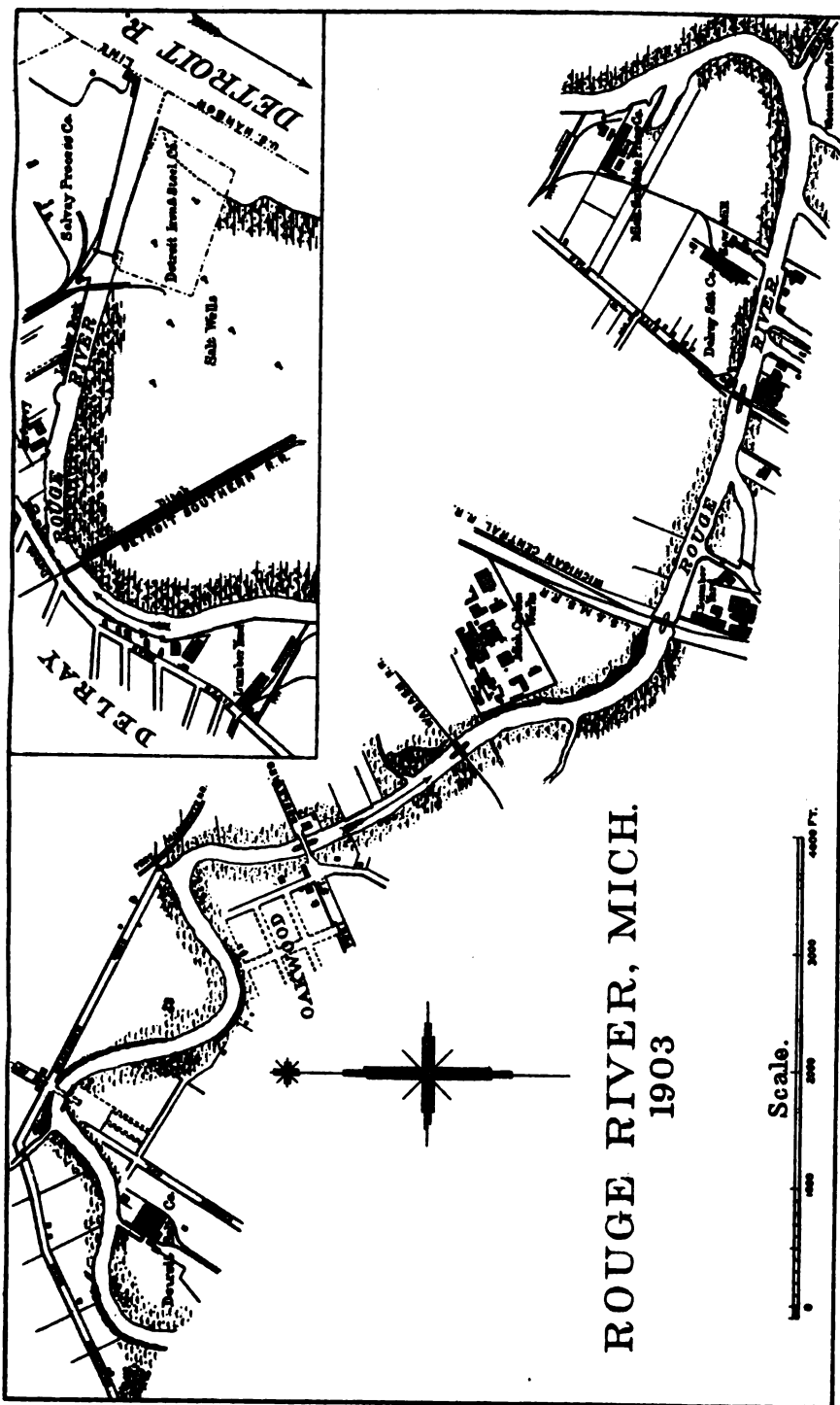
## COMMERCIAL STATISTICS.

### Receipts and shipments by vessel for the calendar year ended December 31, 1902.

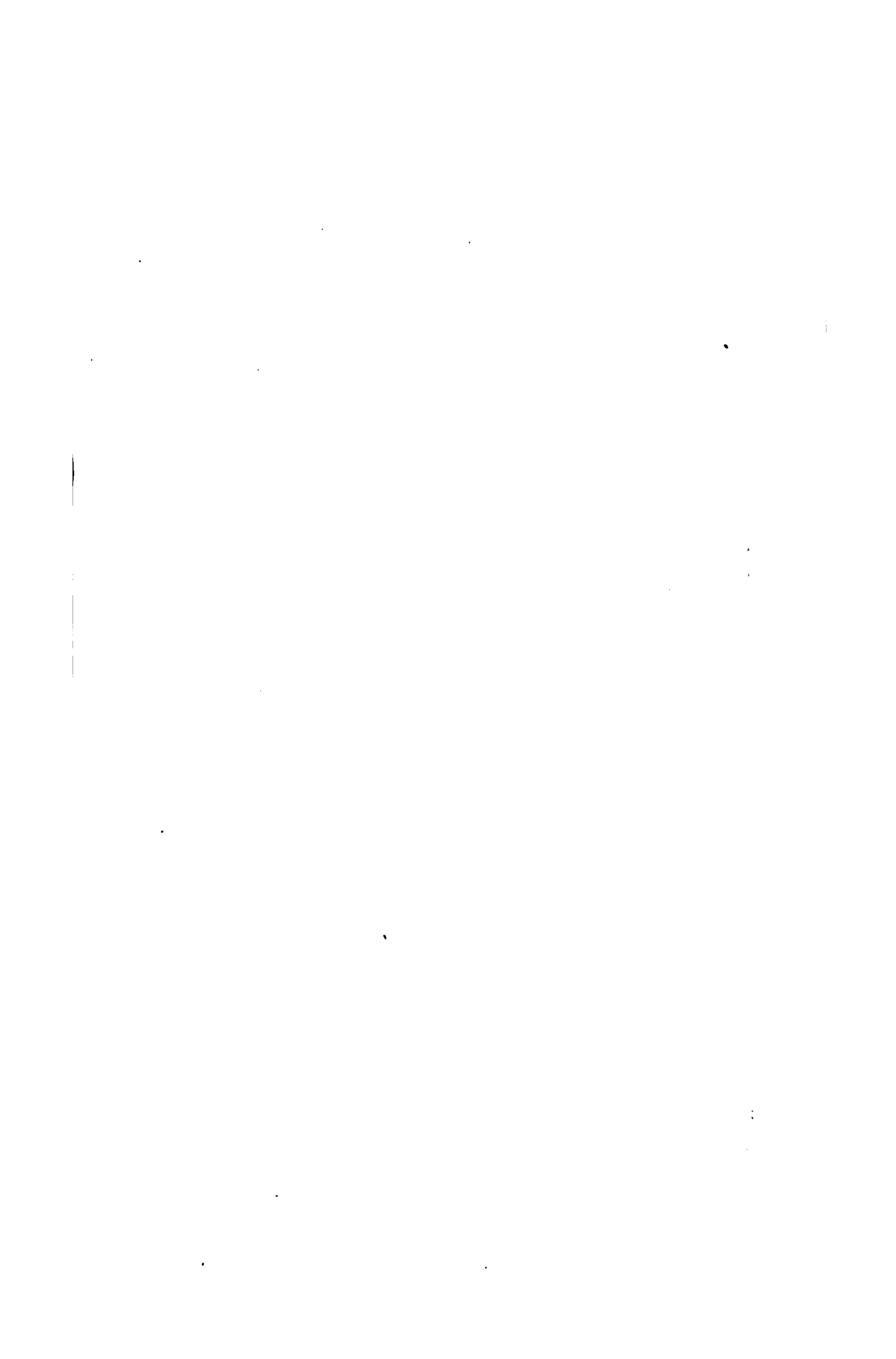
[Compiled from statements furnished by Solvay Process Company, C. W. Restrict, Brownlee & Co., E. B. Foss & Co., Michigan Carbon Works, Dwight Lumber Company.]

Articles.	Received.	Shipped.
	Tons.	Tons.
Cement.....	10,000	-----
Limestone.....	897	-----
Lumber.....	45,800	-----
Soda Ash.....	-----	10,000
Total.....	56,701	10,000









[illegible]

## (c) HARBOR AT MONROE.

The work done at this locality during the fiscal year consisted of dredging under contract with Messrs. G. H. Breymann & Bros., of Toledo, Ohio. Work on this contract was commenced May 21, 1903. It was performed by means of a suction dredge which was much hindered in its work by reason of bowlders and stone imbedded in the material to be handled. Soundings prior to the beginning of the work showed sandy deposits formed since previous dredging had been done, and it was thought that the material could be readily handled by the suction dredge, but it was found that the sand had a large number of loose bowlders and rock scattered through it whose presence could not be determined by sounding. This of course interfered with the work of a dredge of this character. The work was satisfactorily completed June 8, 1903. The channel dredged in this manner was 1,350 feet long and was located at and just below the Monroe docks on the upper portion of the river. It affords a navigable depth of 10 feet from Lake Erie to the docks of the city.

For maintenance of the improvement, repairs to the cribs at the entrance, the sum of \$3,000 should be provided.

*Money statement.*

July 1, 1902, balance unexpended .....	\$1,500.00
June 30, 1903, amount expended during fiscal year .....	1,257.18
July 1, 1903, balance unexpended .....	242.82
<hr/>	
{ Amount that can be profitably expended in fiscal year ending June 30, 1905, for maintenance of improvement in addition to the balance unexpended July 1, 1903 .....	3,000.00
{ Submitted in compliance with requirements of sundry civil act of June 4, 1897, and of section 7 of the river and harbor act of 1899.	

## APPROPRIATIONS.

February 24, 1835 .....	\$30,000.00	June 14, 1880 .....	\$2,000.00
July 2, 1836 .....	15,000.00	March 3, 1881 .....	1,000.00
March 3, 1837 .....	30,000.00	August 2, 1882 .....	1,000.00
July 7, 1838 .....	15,000.00	August 5, 1886 .....	2,000.00
June 11, 1844 .....	20,000.00	August 11, 1888 .....	5,000.00
August 30, 1852 .....	14,000.00	September 19, 1890 .....	5,000.00
June 23, 1866 .....	31,015.27	July 13, 1892 .....	10,000.00
June 10, 1872 .....	10,000.00	August 18, 1894 .....	5,000.00
March 3, 1873 .....	15,000.00	June 3, 1896 .....	5,000.00
June 23, 1874 .....	10,000.00	March 3, 1899 .....	5,000.00
March 3, 1875 .....	10,000.00	June 13, 1902 (allotment) ..	1,500.00
August 14, 1876 .....	5,000.00		
June 8, 1878 .....	2,500.00		
March 3, 1879 .....	2,000.00		
		Total .....	252,015.27

## CONTRACT IN FORCE.

Contract in force with Messrs. G. H. Breymann & Bros., of Toledo, Ohio, at 25 cents per cubic yard, approved January 30, 1903. Date of beginning work, May 21, 1903; date of completion, June 8, 1903.

## 1996 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

## COMMERCIAL STATISTICS.

*Receipts and shipments by vessel for the year ended December 31, 1902.*

[Compiled from statements furnished by Mr. A. S. Dewey, deputy collector, Monroe, Mich.]

Articles.	Received.	Shipped.
	<i>Tons.</i>	<i>Tons.</i>
Coal.....	100	
Fish.....	600	100
Hay and feed.....	10	
Lime and cement.....	2	
Lumber.....	4	3
Salt.....	7	
Stone.....	135	
Sand.....	11	
Total.....	869	108

## P P 7.

## IMPROVEMENT OF BLACK RIVER AT PORT HURON, MICHIGAN.

No work was in progress at this locality during the past fiscal year. The total estimated cost of the improvement from the mouth of the river to the Grand Trunk Railway Bridge, with widths varying from 75 to 160 feet, according to locality, was \$75,000. No estimate of cost of continuing the work to Washington avenue, as required by the subsequent act, was called for by Congress, and none has been submitted. The total amount appropriated to date is \$47,000, and it will require the remaining \$28,000 of the estimate to restore the channel and complete it with depth of 16 feet to the limits contemplated by the approved project. If, however, further operations be limited to maintenance of the improvement as it now exists, an appropriation of \$8,000 for the year ending June 30, 1905, will suffice.

Original estimated cost of 16-foot channel, 1891 ..... \$75,000.00  
 Whole amount expended to June 30, 1903..... 46,554.97

*Money statement.*

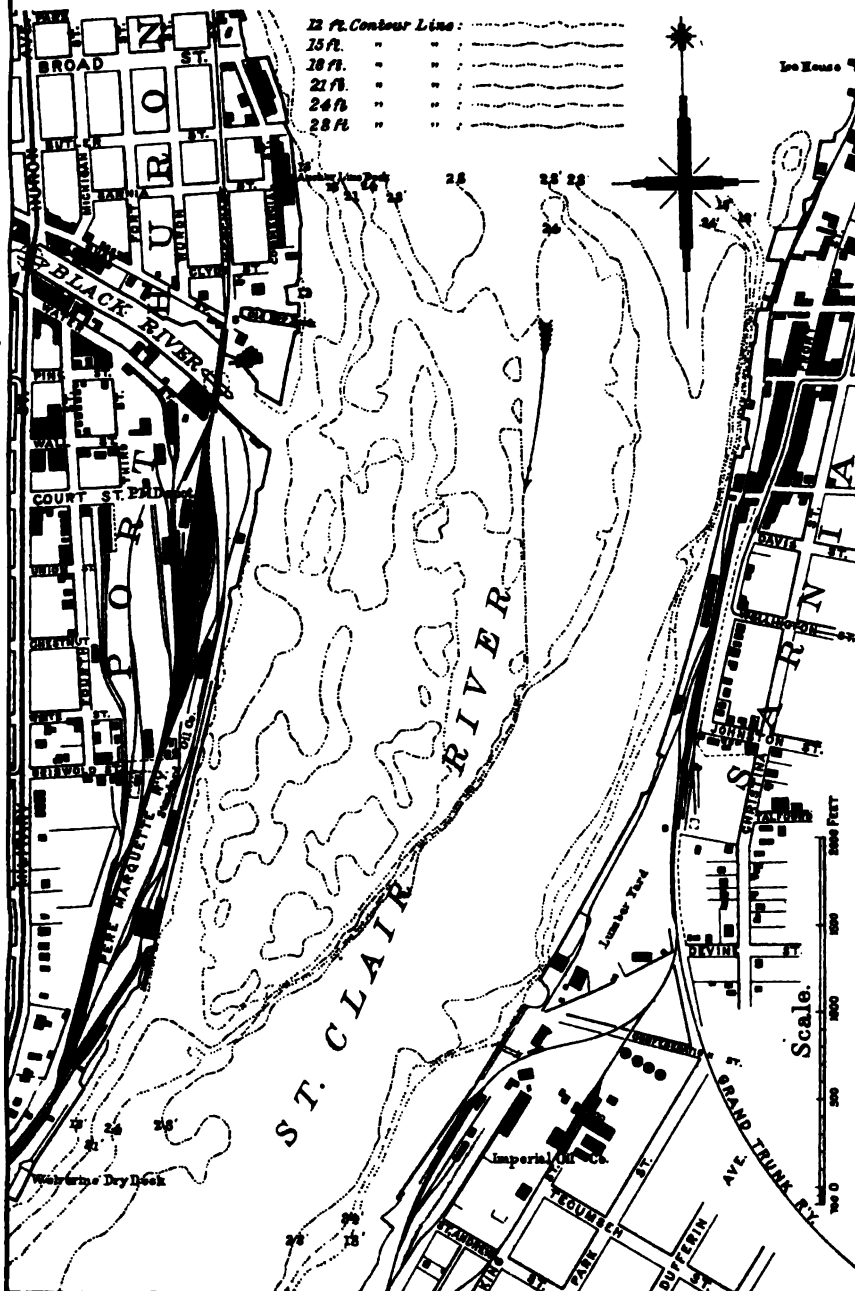
July 1, 1902, balance unexpended..... \$695.03  
 June 30, 1903, amount expended during fiscal year ..... 250.00  
 July 1, 1903, balance unexpended..... 445.03

{ Amount that can be profitably expended in fiscal year ending June 30, 1905, in addition to the balance unexpended July 1, 1903:  
     For works of improvement..... \$10,000.00  
     For maintenance of improvement ..... 8,000.00  
     18,000.00  
 Submitted in compliance with requirements of sundry civil act of June 4, 1897, and of section 7 of the river and harbor act of 1899.

## APPROPRIATIONS.

September 19, 1890..... \$25,000  
 July 18, 1892..... 10,000  
 August 18, 1894..... 4,000  
 June 8, 1896..... 4,000  
 March 8, 1899..... 4,000  
 Total..... 47,000

# MOUTH OF BLACK RIVER, MICH. 1903



ANDREW S. GRAHAM PHOTO-LITHO WASHINGTON, D.C.





1. The first part of the document discusses the importance of maintaining accurate records of all transactions and activities. It emphasizes that this is crucial for ensuring transparency and accountability in the organization's operations.

2. The second part outlines the various methods and tools used to collect and analyze data. It mentions the use of surveys, interviews, and focus groups to gather information from stakeholders. Additionally, it discusses the use of statistical software to process and interpret the data.

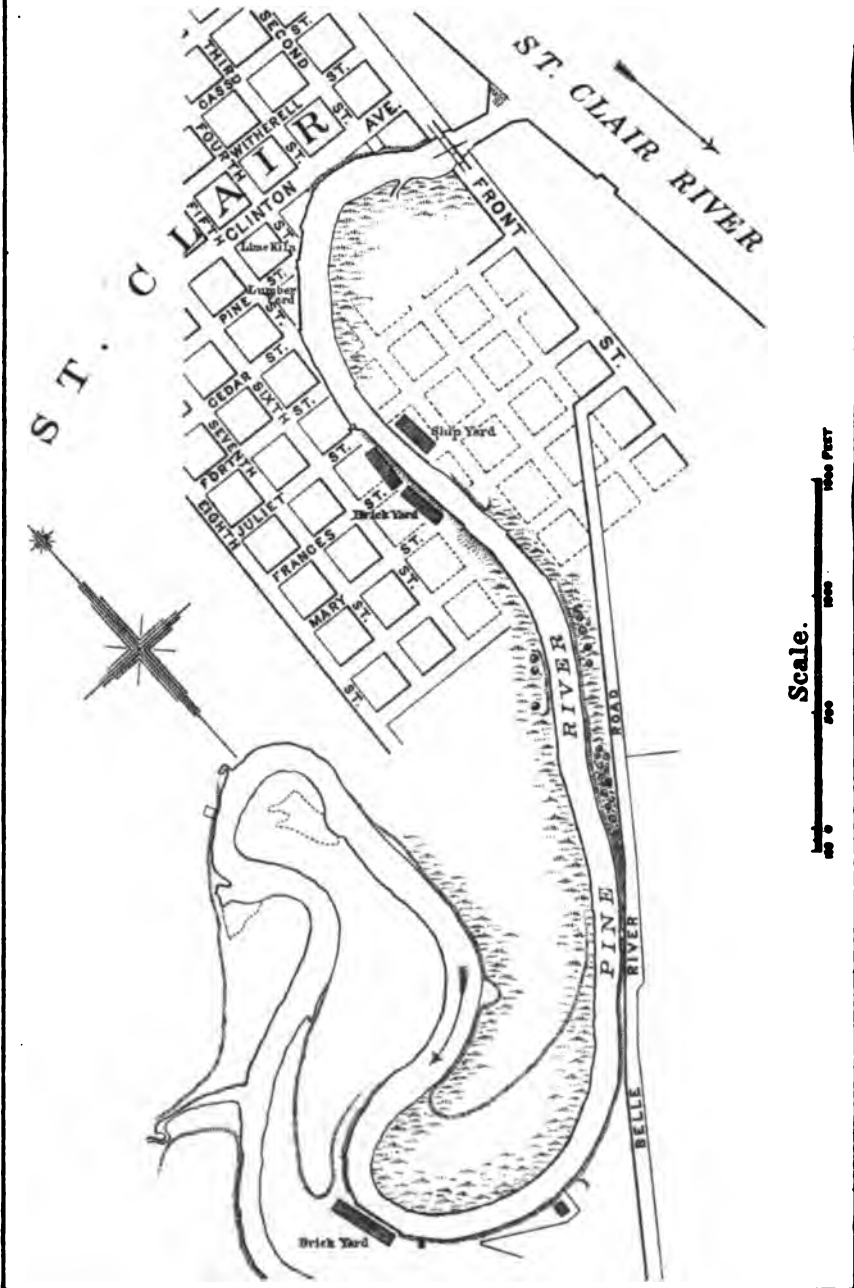
3. The third part describes the results of the research and the conclusions drawn from the analysis. It highlights the key findings and discusses their implications for the organization's strategy and decision-making.

4. The fourth part provides a detailed overview of the organization's current state, including its strengths, weaknesses, and opportunities. It also identifies the main challenges facing the organization and proposes strategies to address them.

5. The fifth part discusses the future prospects of the organization and the potential for growth and innovation. It outlines the organization's vision and mission and describes the steps it is taking to achieve its long-term goals.

6. The sixth part provides a summary of the document and a final conclusion. It reiterates the importance of the research and the findings and expresses confidence in the organization's ability to overcome its challenges and achieve its goals.

# PINE RIVER, MICHIGAN. 1903



ANDREW S. GRAMME, PHOTO-LITHO WASHINGTON, D.C.

## COMMERCIAL STATISTICS.

*Receipts and shipments by vessel for the calendar year ended December 31, 1902.*

[Compiled from statements furnished by Mr. W. R. Chadwick, deputy collector at Port Huron, Mich.]

Articles.	Received.	Shipped.	Articles.	Received.	Shipped.
	<i>Tons.</i>	<i>Tons.</i>		<i>Tons.</i>	<i>Tons.</i>
Brick .....	5,000		Salt .....	84	
Cedar posts .....	320		Shingles .....	570	
Coal .....	48,570		Telegraph poles .....	125	
Gravel .....	10,400	2,600	Sewer pipe .....	1,100	
Lath .....	636		Wood .....	41,550	
Lime and cement .....	1,375				
Lumber .....	18,947		Total .....	123,677	2,600

## P P 8.

## IMPROVEMENT OF PINE RIVER, MICHIGAN.

No work was done at this locality during the past fiscal year. A balance of \$1,335.41 from the last appropriation is on hand, which will probably suffice to meet all cost of maintenance and general contingencies of engineering, office, etc., for some time to come. Further appropriation is therefore unnecessary at present.

Original estimated cost of work, 1895 ..... \$10,560.00  
 Whole amount expended on present project to June 30, 1903 ..... 9,224.59

*Money statement.*

July 1, 1902, balance unexpended ..... \$1,335.41  
 July 1, 1903, balance unexpended ..... 1,335.41

## APPROPRIATIONS.

March 3, 1875 ..... \$5,000  
 June 3, 1896 ..... 5,000  
 March 3, 1899 ..... 5,560  
 Total ..... 15,560

## COMMERCIAL STATISTICS.

*Receipts and shipments by vessel for the calendar year ended December 31, 1902.*

[Compiled from statements furnished by Mr. D. P. Ingles, deputy collector, St. Clair, Mich.]

Articles.	Received.	Shipped.
	<i>Tons.</i>	<i>Tons.</i>
Brick .....		4,848
Coal .....	232	
Stone .....	230	
Wood .....	255	
Total .....	767	4,848

## P P 9.

## IMPROVEMENT OF BELLE RIVER, MICHIGAN.

No work was done at this locality during the past fiscal year. No additional appropriation is necessary, as the unexpended balance of the last one will provide for all probable expenses of maintenance, supervision, etc., for some considerable time to come.

Original estimated cost of work, 1895..... \$31,340.00  
 Whole amount expended on present project to June 30, 1903..... 10,940.46

*Money statement.*

July 1, 1902, balance unexpended ..... \$4,059.54  
 July 1, 1903, balance unexpended ..... 4,059.54

## APPROPRIATIONS.

March 3, 1881 (ice harbor of refuge)..... \$7,000  
 August 2, 1882 (ice harbor of refuge)..... 5,000  
 July 5, 1884 (ice harbor of refuge)..... 2,000  
 June 3, 1896 ..... 5,000  
 March 3, 1899..... 10,000  
 Total..... 29,000

## COMMERCIAL STATISTICS.

*Receipts and shipments by vessel for the calendar year ended December 31, 1903.*

[Compiled from statements furnished by Mr. R. B. W. Beattie, deputy collector,  
 Marine City, Mich.]

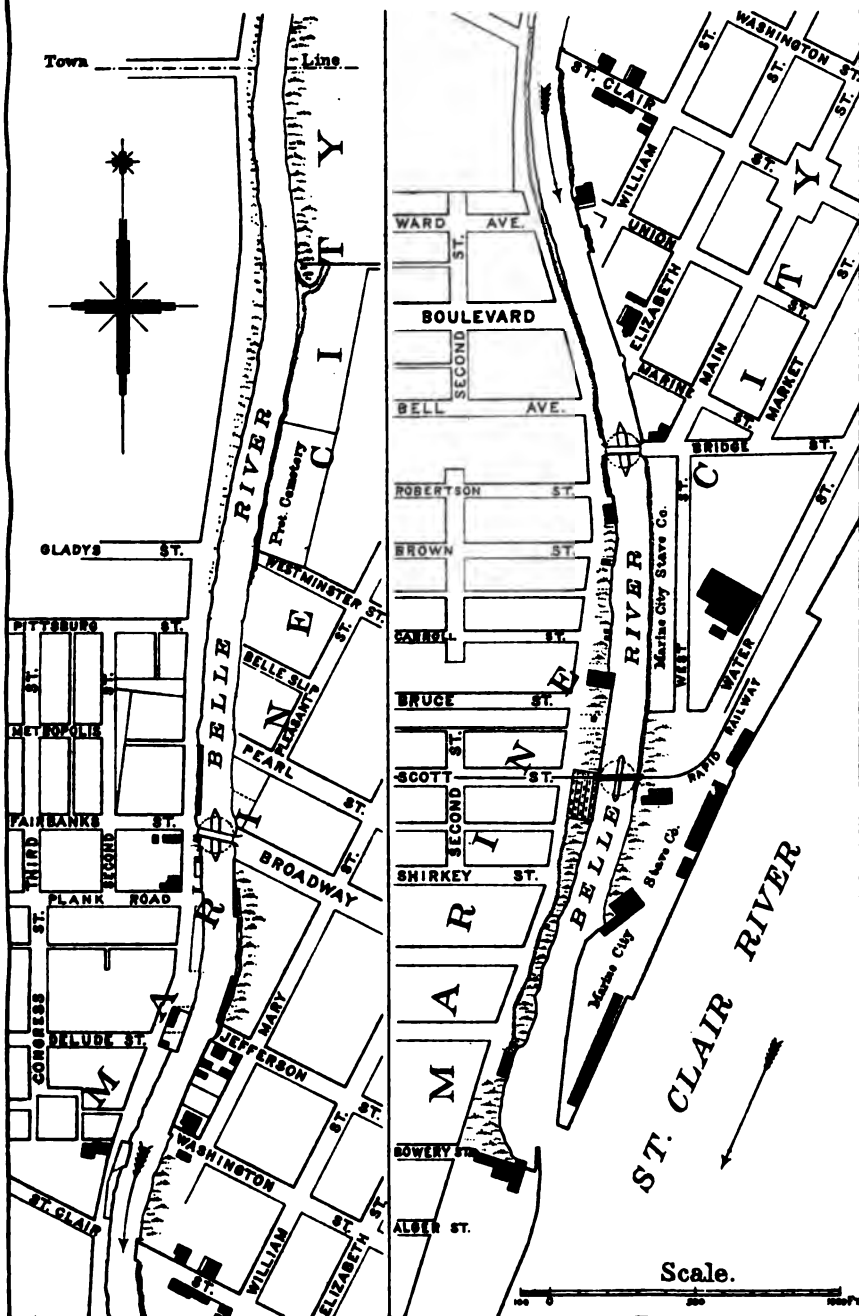
Article.	Re- ceived.	Shipped.	Article.	Re- ceived.	Shipped.
	Tons.	Tons.		Tons.	Tons.
Brick .....	125	.....	Lime .....	480	.....
Cedar posts .....	158	34	Lumber .....	5,848	1,487
Coal .....	1,981	.....	Shingles .....	286	45
Gravel .....	3,547	.....	Stone .....	661	.....
Hay and feed .....	.....	125	Total .....	12,499	1,786
Laths .....	123	45			

## P P 10.

## IMPROVEMENT OF CLINTON RIVER, MICHIGAN.

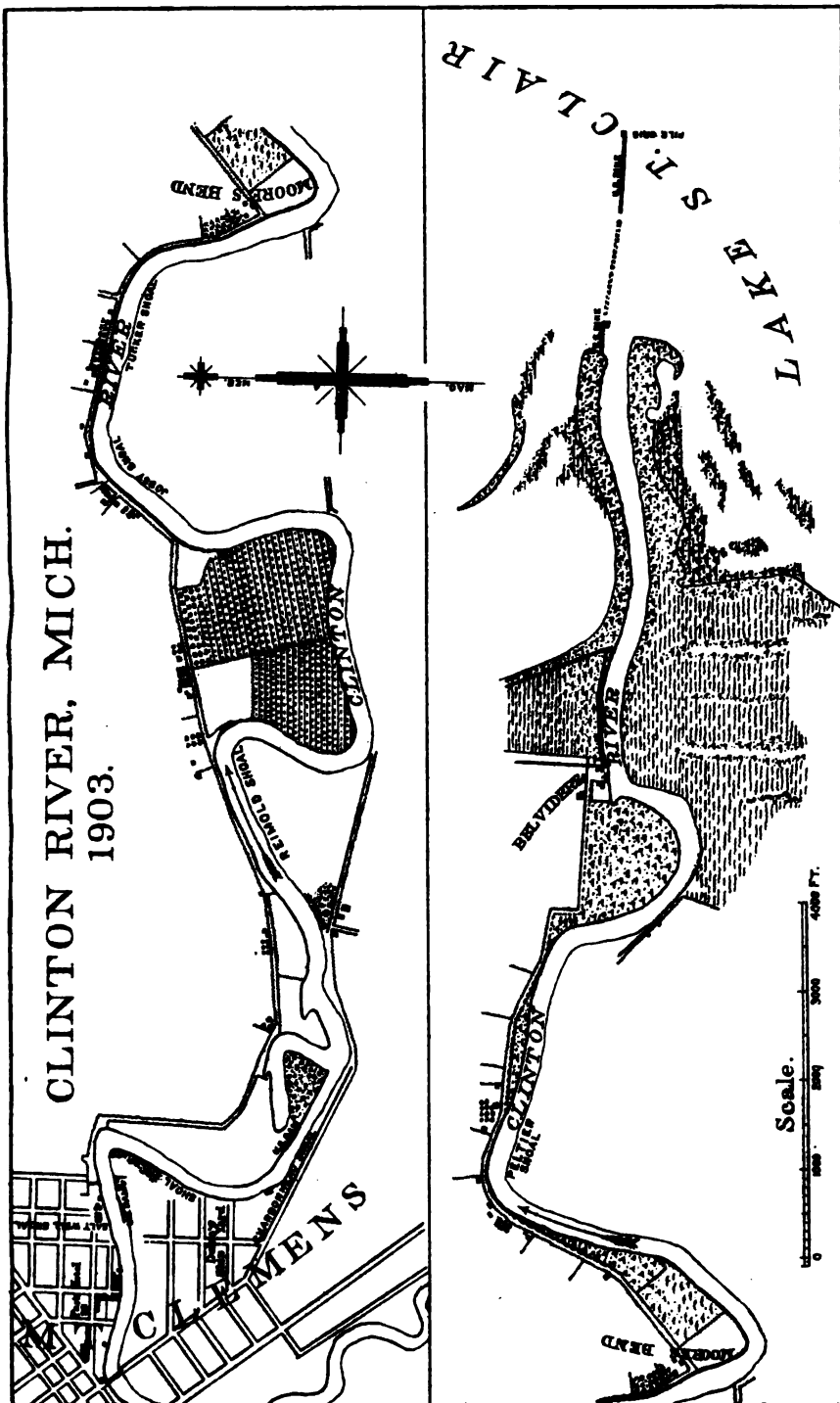
The contract for dredging on this river to restore the channel was made with the Detroit Dredging Company, Limited, of Detroit, Mich., and the contractors expect to begin work the 1st of July. The work which will be done under this contract is believed to be sufficient for the purposes of navigation for the present season. The river, however, is liable to the formation of bars at times of freshet, and additional funds should be provided for maintenance of the improvement. An appropriation of \$5,000 will probably be sufficient.

# BELLE RIVER, MICH. 1903



ANDREW B. GRABAU PHOTO-UNION WASHINGTON D.C.





ANDREW S. GRAHAM, PHOTO-LITHO WASHINGTON D.C.





Original estimated cost of work, 1885, as amended 1899 .....	\$34,564.00
Whole amount appropriated and expended prior to adoption of present project .....	25,500.00
Whole amount expended on present project to June 30, 1903 .....	42,821.93

*Money statement.*

July 1, 1902, balance unexpended .....	\$6,802.41
June 30, 1903, amount expended during fiscal year .....	60.84
July 1, 1903, balance unexpended .....	6,742.07
July 1, 1903, amount covered by uncompleted contracts .....	3,000.00
<hr/>	
{ Amount that can be profitably expended in fiscal year ending June 30, 1905, for maintenance of improvement, in addition to the balance unexpended July 1, 1903 .....	
{ Submitted in compliance with requirements of sundry civil act of June 4, 1897, and of section 7 of the river and harbor act of 1899.	
	5,000.00

## APPROPRIATIONS.

August 30, 1852 .....	\$5,000	September 19, 1890 .....	\$10,000
July 11, 1870 .....	5,000	July 13, 1892 .....	8,564
March 3, 1871 .....	1,500	August 18, 1894 .....	5,000
March 3, 1881 .....	8,000	June 3, 1896 .....	10,000
August 2, 1882 .....	6,000		
August 5, 1886 .....	6,000	Total .....	75,064
August 11, 1888 .....	10,000		

## COMMERCIAL STATISTICS.

*Receipts and shipments by vessel for the calendar year ended December 31, 1902.*

[Compiled from statements furnished by Mr. John T. Rich, collector of customs, Detroit, Mich.]

Article.	Re- ceived.	Shipped.	Article.	Re- ceived.	Shipped.
	Tons.	Tons.		Tons.	Tons.
Cedar posts .....	40	.....	Stone .....	738	.....
Coal .....	18,750	.....	Sand .....	4,363	.....
Lath .....	134	.....	Wood .....	1,060	.....
Lime and cement .....	187	.....	Bolts .....	170	.....
Logs .....	2,730	.....	Total .....	33,868	.....
Lumber .....	5,481	.....			
Salt .....	165	.....			



## APPENDIX Q Q.

### IMPROVEMENT OF WATERS CONNECTING THE GREAT LAKES.

REPORT OF MAJ. W. H. BIXBY, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1903, WITH OTHER DOCUMENTS RELATING TO THE WORKS.

#### IMPROVEMENTS.

- |  |  |
|--|--|
| 1. Ship channel connecting waters of the Great Lakes between Chicago, Duluth, and Buffalo. | 5. St. Clair Flats Canal, Michigan.  |
| 2. St. Marys River at the Falls, Michigan.   | 6. Operating and care of St. Clair Flats Canal, Michigan.                  |
| 3. Operating and care of St. Marys Falls Canal, Michigan.                                  | 7. Detroit River, Michigan.  |
| 4. Hay Lake and Neebish channels, St. Marys River, Michigan.                               | 8. Removing sunken vessels or craft obstructing or endangering navigation. |

UNITED STATES ENGINEER OFFICE,  
*Detroit, Mich., July 20, 1903.*

GENERAL: I have the honor to submit herewith the Annual Report relative to the works under my charge for fiscal year ending June 30, 1903.

Very respectfully, your obedient servant,

W. H. BIXBY,  
*Major, Corps of Engineers.*

Brig. Gen. G. L. GILLESPIE,  
*Chief of Engineers, U. S. A.*

## Q Q 1.

### IMPROVEMENT OF SHIP CHANNEL CONNECTING WATERS OF THE GREAT LAKES BETWEEN CHICAGO, DULUTH, AND BUFFALO.

Operations were in progress in the Detroit, St. Clair, and St. Marys river sections during the past fiscal year, as follows:

*Detroit River and St. Clair River and Lake.*—Dredging was in progress in this section from October 7 to December 31, 1902, and April 16 to June 30, 1903, under three separate contracts, followed in some cases by hired work at same rates. The work was divided between

2 different bad shoals in the main ship channel, with results as follows: (1) At St. Clair Flats canal lower entrance, 60,997 cubic yards, increasing the available channel width by from 80 to 200 feet, and (2) at the middle ground shoal opposite the mouth of Black River, Port Huron, 82,569 cubic yards, increasing the available width by 350 feet at its turn or angle where most troublesome.

During the months of July to December, 1902, and April to June, 1903, and especially in October and November, 1902, the U. S. S. *Hancock*, equipped with sweeping outfit, was engaged in local examinations of the channel at various points in this section from Lake Huron to Lake Erie, where obstructions have been reported by vessel masters. In most cases these reports were found to be erroneous, but in some instances the examinations resulted in the discovery of small shoal areas which had been previously unknown, but none on which a less depth than 19 to 21 feet was found.

A special report on the rainfall, outflow, and evaporation of the Great Lakes, under preparation since 1899, was finally completed in shape for publication.<sup>a</sup>

All this work was under the local charge of Principal Assistant Engineer E. S. Wheeler.

*St. Marys River.*—Extensive examinations with sweeping raft and surveys were in progress in this section throughout the year, covering a total area of about 4½ square miles. These examinations and surveys were made under the direct charge of Assistant Engineer Benno Rohnert, the general supervision being under Assistant Engineer Joseph Ripley, of whose report extracts are given below. By these special examinations, as made in the past few years, the St. Marys River from Lake Superior to Lake Huron has now been carefully swept to 27 feet depth over its entire length and its area of about 31 square miles except an area of about 3 square miles to be done next year near Lake Huron. In several cases during recent years steamer captains and pilots have reported striking sunken obstructions in the dredged channels when subsequent careful sweeping has proved the channel to be entirely clear to a greater depth than the greatest draft of the boat.

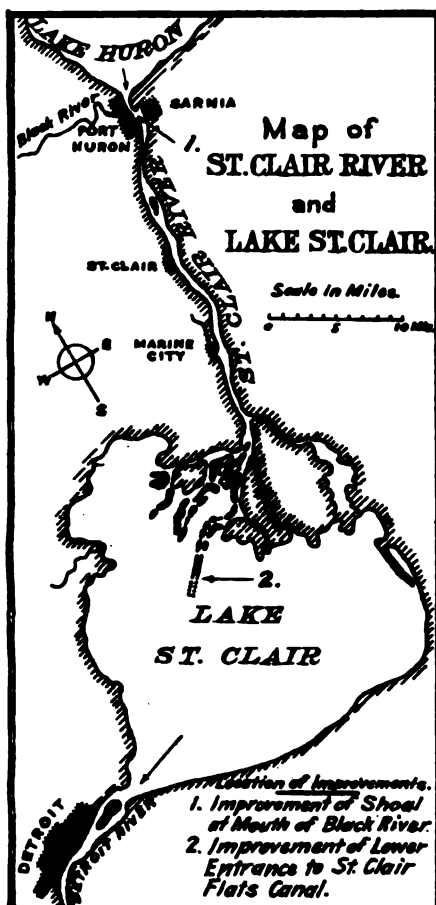
Dredging was in progress in this section from October 29 to December 9, 1902, and from April 22 to June 30, 1903, under three separate contracts. The work was divided between three different very troublesome bends of the ship channel with results as follows: (1) At the upper end of Little Mud Lake, 72,803 cubic yards, adding 125 feet width at the bend; (2) at the lower end of Little Mud Lake, 56,872 cubic yards, adding 175 feet width at the bend; and at Sailors Encampment, 24,642 cubic yards, adding from 15 to 90 feet width at the bend and promising about 90 feet more by the end of the calendar year.

The total expenditure to June 30, 1903, excluding liabilities then outstanding, was \$3,054,420.36,<sup>b</sup> and the total excavation to that date was 10,885,248 cubic yards.

The depth now available over the shoalest part of the ship channel between Chicago, Duluth, and Buffalo is 19 feet at the low-water stage

<sup>a</sup>Printed with report on the survey of the Northern and Northwestern Lakes. (See Appendix F F F.)

<sup>b</sup>Repayment of \$2,778.06 has been deducted from the total expenditure, as explained below the list of appropriations.

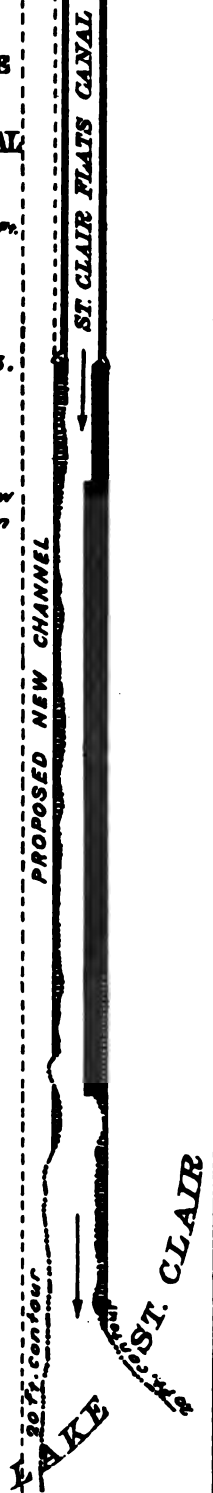
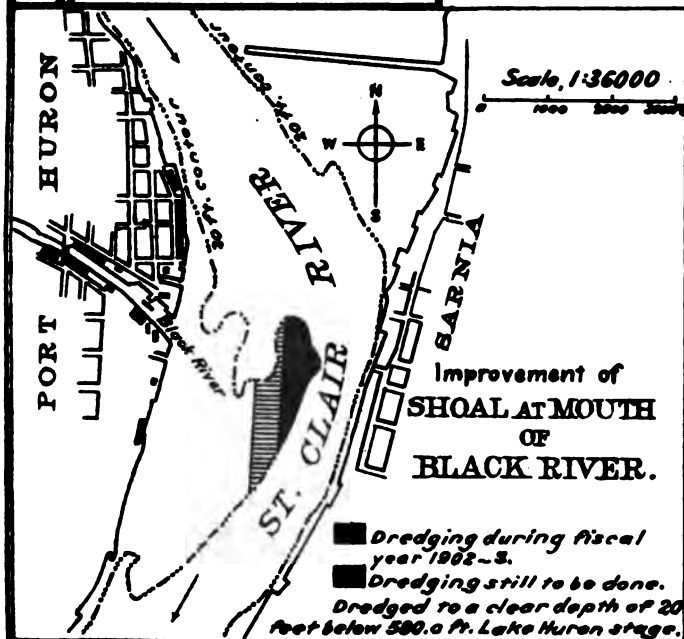
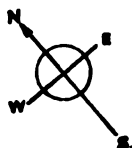


# Improvement of LOWER ENTRANCE TO ST. CLAIR FLATS CANAL

Scale, 1:20000  
0 1000 2000 Ft.

- Dredged during fiscal year 1902-3.
- Dredging still to be done.

Dredged to a clear depth of 20 feet below 575.1 feet above mean tide at New York.





of the 1891 projects, and this limiting depth is confined to that section of the Detroit River which is included between the Lime Kiln Crossing and the south end of Bois Blanc Island. This 1891 low-water stage is one corresponding to a stage at Lake Erie of 572.6 feet above mean tide at New York, or 2.6 feet below high water of 1838. Low water for contracts of 1903 and new projects is assumed at 570.8 at Lake Erie, or 1.8 feet below that of the 1891 projects.

It is proposed to apply the unexpended balance of the ship-channel appropriations, as occasion requires, (1) to widening and deepening the channel at points where such work is needed to make navigation safe and convenient, and (2) to the removal of newly discovered shoals or obstructions in the line of through travel between the specified terminals of the ship channel. No further appropriation for these purposes is required at present.

*Money statement.*

July 1, 1902, balance unexpended .....	\$350,719.39
June 30, 1903, amount expended during fiscal year, less \$16.70 received from sale of condemned Government property .....	<sup>a</sup> 65,139.75
July 1, 1903, balance unexpended .....	285,579.64
July 1, 1903, outstanding liabilities .....	5,497.84
July 1, 1903, balance available .....	280,081.80
July 1, 1903, amount covered by uncompleted contracts .....	26,792.70

APPROPRIATIONS.

July 13, 1892 .....	\$375,000	June 4, 1897, sundry civil act. .....	\$1,090,000
March 3, 1893, sundry civil act. ....	875,000		
March 2, 1895, sundry civil act. ....	500,000	Total .....	3,340,000
June 11, 1896, sundry civil act. ....	500,000		

The following repayment is omitted from the appropriation list, to the footing of which it has heretofore been improperly added, and the amount (\$2,778.06) has been deducted from the total expenditures:

February 19, 1895, repayment of overpayment made R. J. Cram, dredging section 1 .....	\$2,778.06
---	------------

ABSTRACT OF CONTRACTS IN FORCE DURING THE FISCAL YEAR ENDING JUNE 30, 1903.

*Formal contract dated June 10, 1902, for time work by dredging plant.*

Name and address of contractor.	Rate per working hour.	Date of approval.	Date of beginning work.	Date of expiration.	Remarks.
G. H. Breymann & Bros., Toledo, Ohio.	\$17.00	June 17, 1902	Aug. 15, 1902	Indefinite .....	Completed Dec. 31, 1902.

<sup>a</sup> Includes \$3.28 paid by Treasury Department, account Duluth, South Shore and Atlantic Railway Company.

# 2004 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

## *Emergency contracts for time work by dredging plant.*

Name and address of contractor.	Rate per working hour	Date of contract	Date of beginning work.	Date of expiration.	Remarks.
Hickler Bros., Sault Ste. Marie, Mich.	\$15.00	Oct. 27, 1902	Oct. 29, 1902	Close of navigation season, 1902.	Completed Dec. 8, 1902.
The Lake Erie Dredging Co., Buffalo, N. Y.	30.00	.....do.....	Oct. 28, 1902	.....do.....	Completed Dec. 9, 1902.
Hickler Bros., Sault Ste. Marie, Mich.	15.00	Mar. 30, 1903	May 1, 1903	Nov. 11, 1903, approximately.	In force.
The Lake Erie Dredging Co., Buffalo, N. Y.	30.00	Apr. 21, 1903	.....do.....	Oct. 21, 1903, approximately.	Do.
M. Sullivan, Detroit, Mich.	{ a 19.00 b 21.00	{ Apr. 22, 1903	{ May 2, 1903	{ June 2, 1903, approximately.	Completed May 30, 1903.
G. H. Breyman & Bros., Toledo, Ohio.	{ a 17.00 b 21.00	{ Apr. 30, 1903	{ May 10, 1903	{ June 10, 1903, approximately.	Do.

a In St. Clair River.

b In Lake St. Clair.

## REPORT OF MR. JOSEPH RIPLEY, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,  
Sault Ste. Marie, Mich., July 1, 1903.

MAJOR: I have the honor to submit the following report of operations for improving sections 1, 2, 3, and 4 of the 20 and 21 foot channel connecting the waters of the Great Lakes between Chicago, Duluth, and Buffalo during the fiscal year ending June 30, 1903.

### EXAMINATION OF ST. MARYS RIVER FOR SHOALS.

Excepting an area of  $3\frac{1}{2}$  square miles lying between Little Lime Island and Sweets Island, St. Marys River has been swept with suspended raft bars from Lake Superior to Lake Huron, thereby accurately locating all shoals and scattering bowlders on which there is less than 27 feet of water. The total area to date is 28 square miles, of which  $4\frac{1}{2}$  square miles were gone over during the fiscal year ending June 30, 1903. There were 37 flag buoys placed on the 21, 23.6, and 27 foot contours within the area tested which were read in by transit from adjacent triangulation stations. The rectangular coordinates referred to  $\Delta$  19, survey of 1879, and  $\Delta$  Winter Point, survey of 1894-95 were computed and listed for 183 of the flag buoys marking the contours from Point aux Frenes to Lake Huron. No new shoals were found.

### EXAMINATIONS OF DREDGED CHANNELS WITH SUSPENDED RAFT BARS.

In August the waters of, and to the westward of, section 4, lying in upper end of Mud Lake, were swept with raft bars suspended at the improved grade which is 21 feet below 581.5 feet above mean tide at New York. The test showed that the ridge of very soft material which had formerly projected about 2 feet above said grade along west channel line had been reduced to 0.4 of a foot. There were 16 marker buoys placed along channel bank for use during sweeping.

### WIDENING ANGLE AT HEAD OF LITTLE MUD LAKE.

Location, 18 miles from Sault Ste. Marie; emergency contract dated October 27, 1902; the Lake Erie Dredging Company, of Buffalo, N. Y., contractors; rate of hire of dredge *Pan-American*, tug *H. H. Meldrum*, and two dump scows, \$30 per working hour. The plant was placed in operation on October 29 and continued so until December 5, when the work of widening the angle was completed. The dredge worked  $314\frac{1}{2}$  hours, was delayed  $13\frac{1}{2}$  hours, and excavated 72,803 cubic yards scow measurement, of sand, clay, and bowlders, which was deposited in the dumping ground north of Green Point. This improvement opened to navigation a much-needed increase of turning room of 125 feet for a distance of about 2,000 feet. The total cost of the excavation to the depth of 21 feet below low water of 578.9 was \$9,422.50, or  $12\frac{1}{2}$  cents per cubic yard. The rate of excavation per hour was approximately 232 cubic yards.

### WIDENING ANGLE AT FOOT OF LITTLE MUD LAKE.

Location, 21 miles from Sault Ste. Marie. Upon completion of the widening of the angle at the head of Little Mud Lake, the dredging plant, hired from the Lake Erie



Dredging Company under emergency contract dated October 27, 1902, was towed to and began the widening of the angle at the foot of the lake on December 5. Work was continued until December 9, when contract expired at close of season. The dredge *Pan-American* worked 16½ hours at \$30 per hour and was delayed 1½ hours. The 854 cubic yards, scow measurement, of sand, gravel, and bowlders were towed to and dumped in the assigned ground below Everens Point, Mud Lake. Dredging at this angle was resumed on April 22, 1903, under emergency contract dated April 21, 1903, for the same plant at same rate, and during the present season has worked 641.7 hours and removed 55,818 cubic yards, scow measurement, of bowlders, gravel, and sand from an area of 16,800 square yards, increasing width of channel 175 feet to grade of 21 feet below 578.9. Total cost for dredging, \$19,757.50, or \$0.349 per cubic yard, and 86 cubic yards per hour.

#### WIDENING ANGLE ABOVE JOHNSON POINT, SAILORS ENCAMPMENT.

Location, 22 miles from Sault Ste. Marie. Emergency contract dated October 27, 1902; Hickler Bros., of Sault Ste. Marie, Mich., contractors; rate of hire of dredging plant, composed of Dredge No. 8, tug *Marion*, and two dumpscows, \$15 per working hour.

Operations were started October 28, and stopped December 8, 1902. The dredge worked 334 hours, 5 minutes, was delayed by breakages 27 hours, 23 minutes, and removed 10,907 cubic yards of sand, bowlders, and limestone bed-rock from an area of about 2,500 square yards. Under emergency contract dated March 30, 1903, for the same plant, at same rate, dredging was resumed on May 14, 1903, and during the present season the dredge has worked 506.5 hours, and removed 13,735 cubic yards scow measurement of sand, bowlders, and limestone rock from an area of 4,600 square yards while excavating for a clear depth of 21 feet below 578.9. Total cost for dredging \$12,608.75, or \$0.512 per cubic yard, and 29.3 cubic yards per hour. The increase of 90 feet to width of channel will not be available till removal of scattering pieces of rock by the diving outfit. A survey was made of this angle by taking 6,750 soundings from the raft. A map of the survey has been made.

There were 38 stakes driven, 14 flag bouys, and 6 gage boards placed for use of the contractors. A supplementary report was submitted on the improvements already made, and those desirable under projects for 20-21 foot channel, with estimates for expending available balance of appropriations.

Junior Engineer O. E. Heffebower was accidentally drowned by falling out of row boat on June 29, 1903. He was in temporary charge of survey party while sweeping for obstructions in channel near Detour.

Assistant Engineer Benno Rohnert had special charge of the 20 and 21 foot channel improvements.

Very respectfully, your obedient servant,

JOSEPH RIPLEY,  
*Assistant Engineer.*

Maj. W. H. BIXBY,  
*Corps of Engineers.*

#### REPORT OF MR. E. S. WHEELER, ASSISTANT ENGINEER.

ENGINEER OFFICE, U. S. ARMY,  
*Detroit, Mich., July 8, 1903.*

MAJOR: I have the honor to submit the following report of work under my charge connected with the improvement of the ship channel during the fiscal year ending June 30, 1903.

*Dredging.*—The lower entrance to St. Clair Flats Canal was somewhat obstructed by shifting sand. Several boats grounded about half a mile from the piers. Dredge No. 3, owned by Breymann Bros., and employed at \$17 per hour, was sent to the St. Clair Flats Canal, arriving there on the 7th of October, and worked until November 18. In this time she dredged over an area 80 feet wide and 2,700 feet long, removing 20,780 cubic yards of sand and clay at an average cost of 16.7 cents per yard. This work added 80 to 120 feet to the available width of the channel entrance, and there were no further groundings there during the season.

During October there were several groundings of vessels on the shoal opposite the mouth of Black River near Port Huron. The Breymann dredge No. 3 was therefore directed by Major Bixby to go to Port Huron. She arrived there on November 18, and worked until December 31, removing 26,675 cubic yards. Another dredge, No. 7, owned by Muir Brothers and O'Sullivan, was employed at \$12.50 per

hour from December 1 to 13 removing 1,299 cubic yards. The two dredges worked over an area 200 feet wide and 1,600 feet long, removing 27,974 cubic yards of material, and increasing the serviceable width of the channel at this turn 200 feet. The Breyman dredge was again employed by the hour in April and May, 1903, removing 54,595 cubic yards of material and increasing the serviceable width of the channel 150 feet more at the turn. This dredge has been under the immediate charge of Inspector Horace Smith. The total dredging of the year at this shoal averaged 15.4 cents per cubic yard (14.9 cents for the Breyman dredge and 46.6 for the small amount of December work done by the Muir Brothers dredge).

A dredge, *Gladiator*, owned by M. Sullivan, has been employed at \$21 per hour during the months of May and June, 1903, and has worked at the lower entrance to St. Clair Flats Canal, removing 40,217 cubic yards of material at an average cost of 20.3 cents per cubic yard, and has so far improved the channel that no groundings at all have occurred this season, and securing practically 600 feet with.

*Examination of channel with sounding bars.*—A systematic examination of the channel in St. Clair River between Marysville and Russell Island, a distance of 21 miles, was made with sweeping bars during the months of October and November, 1902. The method was as follows:

A sweeping raft belonging to the United States lake survey was obtained; the raft was 120 feet long and carried iron bars 3 inches in diameter suspended by steel cable. The bars could be raised or lowered by means of a windlass. In use the bars were lowered to the desired grade, and the raft towed slowly up and down the channel. Whenever the bars touched the bottom it was shown by the movement of a vertical indicator attached to the bars. A width of not less than 600 feet along both sides of the usual sailing lines was swept over. The position of the raft was determined by placing and locating buoys at the upper and lower ends of selected short reaches in the river; the reaches were usually about 1 mile in length. New buoys were placed from time to time to aid in guiding the raft. No new shoals or obstacles were discovered.

*Discussion of the rainfall, outflow, and evaporation of the Great Lakes.*—The evaporation in the several drainage basins of the Great Lakes has been determined from the rainfall and outflow. This work was begun in 1899, but the results at that time were not accordant. Since then the United States lake survey have made many current observations and have revised and improved their discharged formulæ.

A re-reduction has been made, using the latest formulæ, with results quite consistent and accordant.

Very respectfully,

Maj. W. H. BIXBY,  
Corps of Engineers.

E. S. WHEELER,  
Assistant Engineer.

## Q Q 2.

### IMPROVEMENT OF ST. MARYS RIVER AT THE FALIS, MICHIGAN.

The work now in progress comprises the construction of movable dam, gate machinery, etc., and the acquisition of water front, covered by the old projects of 1882, 1885, and 1886, and their extensions; also the widening and further improvement provided for by the river and harbor act of June 13, 1902.

The total expenditures up to June 30, 1903, are \$4,026,796.25,<sup>a</sup> leaving \$737,068.75 available for further payment for outstanding liabilities and further work.

The diversions provided for by the act of June 13, 1902, allowing \$20,000 for special work at Sailors Encampment, and \$20,000 for an

<sup>a</sup> Repayments amounting to \$39.56 have been deducted from the total expenditures, as explained below the list of appropriations.

international commission and about \$85,000 for St. Clair Canal work as now estimated will leave only about \$611,000 for completion of the 1886 project and for the widening and further improvement above the locks, explained in the June 4, 1900 project (H. Doc. No. 124, 56th Cong., 2d sess.; see p. 3202, annual report 1901).

The unfinished work of the 1886 project will require about \$525,000, and the widening, etc., of the 1900 project will require about \$1,050,000 (making a total of \$1,575,000), so that about \$964,000 more is needed for work to be contracted for in 1903 and 1904, and whose commencement has been authorized, but whose completion has not yet been provided for by actual appropriations.

The operations of the past fiscal year are as follows:

Work was commenced on about 2,500 feet length of the first needed portions of the cofferdam, which must precede actual excavation work of the approved widening of the upper canal.

Surveys were made of the present canal bottom and preliminary plans prepared for the movable dam to be built across the same.

Negotiations were entered into for securing the lands needed for approved widening above the locks and for the proper service of canal entrance below the locks.

Extensive surveys and examinations with sweeping raft were in progress during favorable weather, in continuation of similar work done during the three previous working seasons, and in connection with work on the 20–21-foot ship channel improvement. As a result of these examinations the full width of natural and improved channels through the entire length of the river, except an area of about 3½ square miles in the vicinity of Lime Island, has been thoroughly explored, the contours of depths between 20 and 28 feet, both inclusive, have been accurately located, and all shoals that might menace navigation have been fully developed by soundings.

Further details of operations are given in the report of Assistant Engineer Joseph Ripley, under whose immediate supervision this work has been carried on.

*Water levels.*—Daily readings of water gauges above and below the locks of the St. Marys Falls Canal, Michigan, were made throughout the year and their monthly means and differences computed.

The commerce passing through the St. Marys River, as shown by the accurate statistics of traffic through both the Canadian and American locks at the Sault for the navigable season of 1902, a period of 264 days, was 35,961,146 tons of freight, valued at \$358,306,300. The number of passengers reported in transit through the locks was 59,377.

The movable dam, the property acquisition, and their contingencies are now estimated at \$525,000, and the new widening of the 1902 act, at \$1,050,000, so that, as explained at the head of this report, a further appropriation of \$964,000 is still needed to complete work already covered by past river and harbor acts, and should be appropriated in time for use in 1904.

Reports and estimates as to the full cost of the above approved widening and of an additional lock are to be submitted to Congress at its next session.

## 2008 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

*Money statement.*

July 1, 1902, balance unexpended .....	\$766,956. 31
June 30, 1903, amount expended during fiscal year, less \$25.25 received from sale of condemned Government property, and \$25 exchange allowance for old typewriter .....	a 29,887. 56
July 1, 1903, balance unexpended .....	737,068. 75
July 1, 1903, outstanding liabilities and diversions of act of June 13, 1902. ....	125,736. 17
July 1, 1903, balance available .....	611,332. 58
{ Amount (estimated) required for completion of existing project .....	963,667. 42
{ Amount that can be profitably expended in fiscal year ending June 30, 1905, in addition to the balance unexpended July 1, 1903. ....	964,000. 00
{ Submitted in compliance with requirements of sundry civil act of June 4, 1897. ....	

## APPROPRIATIONS.

On past finished projects of 1856 to 1885, \$2,875,692, including \$10,000 diverted from Great Lakes harbors appropriation of 1864. On present project:

August 5, 1886 .....	\$250,000	August 18, 1894, sundry civil act .....	300,000
August 11, 1888 .....	1,000,000	March 2, 1895, sundry civil act .....	483,865
September 19, 1890 .....	900,000		
March 3, 1891, sundry civil act .....	600,000		
March 3, 1893, sundry civil act .....	1,230,000	Total .....	4,763,865

The following repayments of amounts expended are omitted from the appropriation list, to the footing of which they have heretofore been improperly added, and the total (\$39.56) has been deducted from the total expenditures.

Receipts from sales of fuel to officers, January, May, and June, 1887 .....	\$26. 63
Repayment of disallowance of part voucher 19, August, 1894 (see p. 2895, Report Chief of Engineers, 1894) .....	12. 13
Repayment of disallowance of part voucher 24, September, 1896 .....	. 80
	39. 56

## ABSTRACTS OF CONTRACTS IN FORCE.

Name and address of contractor.	Form of contract.	Date of contract.	Rate.	Date of beginning work.	Date of expiration.	Nature of contract.	Completed.
Louis Belanger, Sault Ste. Marie, Mich.	Emergency.	1903. Jan. 13..	39 cents per cubic yard.	1903. Jan. 13..	1903. Feb. 27..	Furnishing and delivering clay.	1903. Feb. 27.
Percy H. Sheppard, Sault Ste. Marie, Mich.	...do ..	...do ..	...do ..	Jan. 14..	Feb. 28..	...do ..	Feb. 21.
The Soo Lumber Co., Sault Ste. Marie, Mich.	...do ..	1902. Oct. 16..	\$26.80 per thousand feet, B. M.	Jan. 2...	Feb. 1a..	Furnishing and delivering fir timber.	Feb. 6.

a Approximate.

## REPORT OF MR. JOSEPH RIPLEY, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,  
Sault Ste. Marie, Mich., July 1, 1903.

MAJOR: I have the honor to submit the following report of operations for improving St. Marys River, Michigan, during the fiscal year ending June 30, 1903:

Preparatory to widening the canal so as to make an additional channel way 108 or

a Includes \$19.32 paid by Treasury Department, account Michigan Central Railroad Company.

more feet wide, passing between the central and north abutments of the railway swing bridge, the site to be excavated was partially inclosed with a cofferdam. The labor party excavated a trench 6 feet wide and from 3 to 20 feet deep to bed rock for a distance of 2,500 feet alongside of north pier of canal and 30 feet distant therefrom.

Under emergency contracts dated January 13, 1903, Louis Belanger and P. H. Sheppard delivered 5,967 cubic yards of clay at 39 cents per yard. The clay was carefully puddled in the trench.

Under emergency contract dated October 16, 1902, the Soo Lumber Company in January delivered and piled on canal lands 258,432 feet B. M. of Pacific coast fir for \$26.80 per thousand.

The labor party excavated a channel for a stream of water 10 feet wide and 2 feet deep between canal lands and Island No. 5 to keep tramps from camping on the island.

The floors of coal bins in basement of power house were raised 5 inches with concrete, a drain being left adjacent to walls to keep the coal dry.

A concrete sidewalk 5 feet wide and 403 feet long was built across canal grounds.

Under special permits from the Secretary of War, dredging in the river by private parties included the removal of cofferdams at inlet and at forebay of the water-power canal, the deepening of shoals in front of the Chesbrough and the Water-Power Company's docks, the deepening of approach to Hickler Brothers' shipways, and the making of slips adjacent to the Chesbrough and Kemp docks. The 171,500 cubic yards of material excavated were deposited in the river at specified dumping grounds under the supervision of a Government inspector.

A hydrographic survey of the canal was made in January and February, extending from the locks to a line 1,000 feet beyond the southwest pier. The soundings, which numbered 79,335, were taken 5 by 5 feet apart through the ice, and were referenced to 148 cross-section stakes located by transit pointings. All the soundings have been reduced and 58,200 of them mapped on tracing linen.

The face line of piers for proposed widening of canal were marked with 25 stakes. The northern boundary of lands required of the Chandler-Dunbar Power Company by the United States for canal purposes was staked out and three of the corners permanently marked by a stone monument and 2 bolts fox wedged into bed rock.

The buildings on the lots north of Water street were located.

An examination of the Spry shoal was made with suspended raft bars, and the depth of water over the shoals was found to be about 1 foot more than the grade to which it had been improved. A shoal has recently formed about 1,000 feet upstream from former site of the Spry shoal with only 18 feet depth on it at mean stage of water.

An inventory was taken of all the Government property on hand. Most of the lake survey property heretofore stored in canal warehouse was delivered aboard the U. S. S. *Sarch*.

The two self-registering gauges, one on southwest pier above locks, and the other on northeast pier below locks, were regularly inspected, and the elevations of water surfaces at twenty-minute intervals were scaled from the rolls.

*Water levels.*—Daily readings of staff gauges above and below the locks of the St. Marys Falls Canal, Michigan, were taken throughout the year, and their monthly means and differences are as follows:

[Elevation, in feet, above mean tide at New York.]

Month.	Monthly means.		Mean difference.
	Above the locks.	Below the locks.	
1902.			
July .....	602.399	582.113	20.286
August .....	602.379	582.228	20.151
September .....	602.419	582.169	20.250
October .....	602.322	581.839	20.483
November .....	602.345	581.781	20.564
December .....	602.072	581.682	20.540
1903.			
January .....	601.764	582.742	19.012
February .....	601.488	582.471	19.012
March .....	601.498	581.778	19.715
April .....	601.614	581.316	20.298
May .....	602.050	581.702	20.318
June .....	602.458	581.918	20.540

## 2010 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

Changes affecting navigation of St. Marys River, such as newly constructed docks, dredged approaches, increased channel widths, erroneous position of aids, etc., affecting the navigation of St. Marys River and the charts thereof, were reported as follows:

\* \* \* \* \*

All surveys for locations, etc., were made and, when necessary, sketches prepared and submitted.

Studies were made of 10 additional designs for a movable dam; plans were drawn, estimates of cost made, and efficiency of types considered.

In case of an accident happening whereby the lock gates should be carried out, the movable dam must be sure of operation and efficient in stopping rush of water through canal. Tests were made on a 4-foot model of a circular caisson with favorable results when velocity of flow in flume was 12 feet per second. The maximum velocity in canal may be as great as 15 feet per second.

Drawings were made for new 12-inch cylinder valve engines for culverts of the Poe lock, and specifications prepared for furnishing 10 of the engines.

Studies with drawings of gate engines for new lock were made.

All of the drawings on file in this office were rearranged, and a card index of the same prepared.

Negotiations were entered into for acquiring lands on north side of canal, and for purchase of lands below the Weitzel lock, needed for canal purposes.

The receipt from sale of 1,603 charts of the Great Lakes and connecting rivers amounted to \$301.56.

\* \* \* \* \*

The receipts for condemned property sold at auction on October 15 amounted to \$50.90.

The formal opening of the Michigan Lake Superior Water Power Canal was celebrated October 25, 1902.

I was assisted on the surveys by Assistant Engineer B. Rohnert, and on movable dam studies since February by Assistant Engineer L. C. Sabin.

Very respectfully, your obedient servant,

JOSEPH RIPLEY,  
*Assistant Engineer.*

Maj. W. H. Bixby,  
*Corps of Engineers.*

---

### Q Q 3.

#### OPERATING AND CARE OF ST. MARYS FALLS CANAL, MICHIGAN.

This service is provided for from the permanent indefinite appropriation for operating and care of canals and other works of navigation under section 4 of the river and harbor act of July 5, 1884.

The progress of improvement of this waterway is explained, under the heading of the improvement of St. Marys River at the Falls. (See Appendix Q Q 2.)

During the fiscal year the canal was in service 250 days, the closed period of 115 days being from December 11, 1902, to April 5, 1903. The commerce thus passed through this single United States canal included over 31,600,000 tons of freight, the latter being an increase of 10 per cent over the previous year. This freighting is over three times that of the Suez Canal by the year, and over six times the same by any single month during the navigation seasons.

The total delays that occurred in locking vessels during the year amounted to 204 hours, of which 69 related to the Poe lock, and 135 to the Weitzel lock, mainly due to minor mishaps to lock machinery, tow lines fouling in propellers, sunken logs and fenders fouling on miter sills, and broken gate cables.

Navigation was entirely blocked for 1.5 hours by an accident to the machinery of the railroad swing drawbridge across the canal above the locks.

The service of the canal was slightly interfered with during the year by reason of labor strikes involving the tugboat firemen and licensed

employees. The trouble would have been much more serious except that the strikers made special favorable allowances to all tug service within the canal limits.

During the period of suspended navigation—December to April—both locks, including all operating machinery, were overhauled and put in complete repair. Several hundred feet length of canal pier superstructure was also extensively repaired. The work was of the usual routine character.

Copy of report prepared by Mr. Joseph Ripley, assistant engineer and general superintendent of the canal, is submitted herewith, the statistical tables, details of service, repairs, accidents, and the statistics of commerce being especially interesting.

The estimated amount required for the year ending June 30, 1904, is \$113,000, to be applied, approximately, as follows: For pay rolls, \$72,000; for repairs, \$24,000; for general supplies, \$8,000; for electric lighting buildings, locks, and grounds, \$3,000; and for office expenses and general contingencies, \$6,000.

*Summary of expenses for operating and care of St. Marys Falls Canal, Michigan, for the fiscal year ending June 30, 1903:*

Pay rolls.....	\$67, 119. 26
Repair material and nonpersonal services on same.....	5, 991. 72
General supplies.....	5, 334. 29
Electric lighting.....	3, 061. 81
Contingencies, including office materials.....	2, 369. 72
<b>Total.....</b>	<b>83, 876. 80</b>

*Money statement.*

Expenses to June 30, 1902.....	\$1, 050, 357. 63
Outstanding liabilities to June 30, 1902.....	6, 109. 71
<b>Total expenses to June 30, 1902.....</b>	<b>1, 056, 467. 34</b>
Expended during fiscal year ending June 30, 1903.....	\$82, 946. 09
Deduct outstanding liabilities pertaining to preceding year.....	6, 109. 71
	76, 836. 38
Add outstanding liabilities June 30, 1903.....	7, 040. 42
	<b>83, 876. 80</b>
<b>Total expenses to June 30, 1903 (including outstanding liabilities).....</b>	<b>1, 140, 344. 14</b>

*Estimate.*

Amount (estimated) for fiscal year ending June 30, 1904.....	\$113, 000. 00
Balance from allotment for preceding year (in round numbers).....	26, 000. 00
<b>Additional allotment required for fiscal year ending June 30, 1904.....</b>	<b>87, 000. 00</b>

*Expenses for operating and care of St. Marys Falls Canal, Michigan.*

1882.....	\$31, 207. 48	1894.....	\$55, 213. 09
1883.....	35, 509. 70	1895.....	50, 908. 67
1884.....	31, 212. 93	1896.....	60, 763. 28
1885.....	27, 242. 45	1897.....	78, 104. 05
1886.....	25, 400. 95	1898.....	58, 890. 72
1887.....	22, 138. 92	1899.....	90, 307. 94
1888.....	29, 898. 72	1900.....	79, 293. 26
1889.....	30, 749. 45	1901.....	75, 475. 33
1890.....	34, 323. 85	1902.....	87, 693. 80
1891.....	48, 330. 89	1903.....	83, 876. 80
1892.....	61, 389. 74		
1893.....	42, 412. 12	<b>Total.....</b>	<b>1, 140, 344. 14</b>

## 2012 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

### *Statement of receipts and expenses for fiscal year ending June 30, 1903.*

#### Receipts:

Balance at close of fiscal year ending June 30, 1902 (including out-standing liabilities) .....	\$22,537. 61
July 16, 1902, allotted .....	88,000. 00
October 31, 1902, proceeds of sale of condemned Government property ..	16. 20

110,553. 81

Expenses..... 83,876. 80

Balance at close of fiscal year ending June 30, 1903..... 26,677. 01

#### REPORT OF MR. JOSEPH RIPLEY, ASSISTANT ENGINEER AND GENERAL SUPERINTENDENT.

UNITED STATES ENGINEER OFFICE,  
*Sault Ste. Marie, Mich., July 1, 1903.*

MAJOR: I have the honor to submit the following report relative to operating and care of St. Marys Falls Canal, Michigan, for the fiscal year ending June 30, 1903:

#### ORGANIZATION.

The regular force of 88 persons, viz, 1 general superintendent, 1 superintendent, 4 clerks, 1 chief engineman, 3 assistant superintendents, 1 overseer, 6 lock masters, 6 enginemen, 7 watchmen, 1 storekeeper, 2 recorders, 9 first-grade lockmen, 9 second-grade lockmen, 15 third-grade lockmen, and 22 linemen were severally employed from nine to twelve months in locking boats, office work, and care of property.

There were 15 laborers employed eight months in repairing piers, grading and care of grounds.

Carpenters, painters, stonecutters, and teamsters were occasionally employed.

#### REPAIRS.

The ordinary maintenance and fitting-out repairs included the fixing or renewal of all damaged, worn-out, or broken parts of the operating machinery, the painting of gates, the refilling of piers, the replacing of broken masonry with concrete, and the removal of obstructions.

Special repairs were made during the winter on the Poe Lock as follows:

The lock was pumped out to replace the broken sheaves from 7.30 p. m. August 12 to 5.15 p. m. August 13. While this repair work was in progress the machinery, floors, and culverts were carefully inspected, and minor repairs were made where needed.

While the lock was pumped out November 4, for purpose of replacing water with oil in the pressure pipes, a broken guard plate over cable sheaves on platform below lower gates was replaced with a new casting. Some loose planks in the floor were respiked; otherwise the machinery and submerged parts of lock were in good order.

After closing for the winter season the regular operating force was employed in laying up the lock, removing oil from the pressure pipes, taking gate and valve engines apart, cleaning out well above lock, and placing timbers to shore up piers.

One of the Westinghouse engines was taken apart and broken bolt and strap replaced with new ones. Permanent platforms were built around these engines in basement of power house.

The turbine plant was overhauled and fitted out. Three of the Oregon fir timbers carrying turbine shafting were replaced with oak timbers. Two pairs of new bevel gears were fitted in place on the shafting and the shafting lined up in position.

The hydraulic pumps, gate and valve engines were thoroughly repaired.

Two new 12-inch valve engines were installed in the inlet culverts.

The interior of intermediate and lower lock gates was cleaned by removing with wire brushes all of the rust, paint, etc., and using a wash of oxalic acid diluted 6 to 1. After drying, the plates were rubbed with waste and then painted one coat of carbon paint.

Repairs to lock floor were made by cutting and threading some 800 rods in the upper end of filling culverts for turnbuckles. The damaged planking of lock floor was replaced with new planks, and ten of the openings in culvert walls were enlarged.

All broken pieces in masonry and hollow quoins were repaired with concrete.



The repairs to the Weitzel Lock included patching break in suction pipe, turning sheaves in well holes, overhauling turbines, valve and gate engines, and replacing 200 broken rods in culverts with new ones, and repairs to hydraulic force pumps.

The repairs to canal piers included placing of timber struts where piers were undermined by pieces of ledge rock falling into the canal, and the repair of 500 feet of timber superstructure to south pier below the Weitzel Lock, and the cleaning out of the wells at head of Weitzel and Poe locks located between the head walls and the miter walls of the upper guard gates.

#### ACCIDENTS.

Among those resulting in injury to persons there were four fatalities.

Kenneth McCawley, sailor on steamer *Empire City*, while heaving boat out of Poe Lock, October 5, was struck by line and died in Marine Hospital from injuries. The drownings in the canal numbered three: Lee F. Johnston November 11, 1902, Thomas Holmes April 12, and P. Trudo June 6, 1903.

The mate of barge *Harvey Bissel* was seriously injured by being struck on head by broken chock August 14, 1902.

A fireman on steamer *H. C. Frick* broke his arm by falling in hold of boat November 5, 1902.

Adolph Pigeon, canal diver, narrowly escaped suffocation from broken air hose November 10, 1902.

There were 45 minor accidents resulting in damage to property, such as breaking of 49 pieces of timber in canal pier, 1 girder in safety gates, 18 pieces of coping from lock walls and safety gate abutments, the pulling out of 4 snubbing posts, and the twisting of decking and railings of gates.

#### DELAYS.

*Poe lock.*—The Poe lock was delayed during the year 68 hours and 59 minutes, as follows: 4 hours 35 minutes due to removing rope fenders lodged against miter sills of gates, 1 hour 10 minutes to tow lines getting fouled in steamers' wheels, 30 minutes waiting for tugs to assist vessels out of lock, 21 hours 45 minutes to repairing and placing broken guide sheave, 1 hour 50 minutes to backing vessels out that were unable to lock with others, 4 hours 30 minutes to grounding of overloaded vessels on platform, 28 hours 53 minutes pumping out lock to repack valve engines preparatory to substituting oil for water in the pressure pipes, 3 hours 45 minutes repairing broken cable fastenings, 1 hour 15 minutes to vessels binding in lock, and 16 minutes to tug breaking her steering gear while in lock.

*Weitzel lock.*—The total of delays in this lock was 135 hours 13 minutes: 1 hour 42 minutes removing rope fenders and sunken logs from miter sill, 1 hour 40 minutes repairing broken cable fastenings, 79 hours 15 minutes repairing broken fender strap on northeast gate, making it necessary to pump out lock; 1 hour replacing worn-out cable, 2 hours 16 minutes boats grounding on platform, 59 hours 20 minutes pumping out lock to repair and repack valve engines and test pipes preparatory to using oil in pressure pipes.

In addition to the above delays, navigation through the canal was blocked for 1½ hours by railroad swing bridge being disabled by breaking throttle valve of engine while swung across canal.

#### STRIKE OF TUGMEN'S ASSOCIATION.

This strike, which was inaugurated April 27, 1902, was continued without interfering with the canal service and till settlement on September 4.

#### REPORTS.

The most important of the special reports submitted was that pertaining to statistics of commerce passing the American and Canadian canals at Sault Ste. Marie, Mich., and Ontario during the calendar year 1902.

Other special reports prepared and submitted related to data pertaining to the Detroit River commerce, classification and duties of employees, details as to occupation of Islands 1 and 2, removal of Indians from Island No. 4, landing of ferry steamer *Fortune* at Fort Brady pier, ice-cutting privileges, and manner of operating locks.

Specifications for 10 new valve engines were prepared and submitted.

## 2014 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

## PERMITS.

Under date of December 10, 1902, the Secretary of War granted the Michigan Lake Superior Power Company permission to cross the St. Marys Falls Ship Canal with an overhead electric transmission line. No work has been done under this permit.

The War Department, under date of December 29, 1902, authorized H. D. Ray to lay up the steamer *D. Leuty* and barge *R. Bottsford* for the winter at the Government piers. The boats were tied up at Fort Brady pier during the winter, and cleared for lower lake ports April 11.

Under date of January 17, 1903, the Secretary of War permitted the Sault Ste. Marie Bridge Company to occupy a portion of the United States Canal grounds, piers, etc., for the purpose of landing material and repairing their railroad drawbridge across the canal. Work under this permit was begun March 19 and completed March 31.

The Chandler-Dunbar Water Power Company were granted a permit under date of February 14, 1903, by the Chief of Engineers, U. S. Army, for the purpose of hauling clay and other building material across the canal and grounds. No work has been done under this permit.

Under date of February 17, 1903, the Secretary of War granted permits to Alf. Richards and W. H. Stribling to cut and take ice from the canal. During the winter Alf. Richards cut ice from an area of 16,000 square yards, and W. H. Stribling from an area of 13,200 square yards.

A special report was submitted upon the application of the St. Marys Power Company relative to certain water-power constructions in the rapids of the St. Marys River.

Under date of May 29, 1903, the Secretary of War revoked license granted to the Canadian Pacific Railway Company October 28, 1900, for establishing and maintaining a branch telegraph office in the office building at the canal.

On March 10, 1903, the Edison Sault Electric Company were permitted by the Secretary of War to construct new power station, extend their embankment, and make new tail race outside of Island No. 3 in St. Marys Rapids, being an extension of prior permits dated April 4, 1901, and August 13, 1892.

## STATISTICAL REPORT OF LAKE COMMERCE.

*Through canals at Sault Ste. Marie, Mich., and Ontario for the fiscal year ending June 30, 1903.*

Items.	United States Canal.	Canadian Canal.	Total.
Vessel passages.....number..	16,615	4,851	21,466
Lockages.....do.....	9,140	3,482	12,572
Registered tonnage.....net tons..	26,557,413	4,445,586	31,003,999
Freight tonnage.....do.....	31,628,366	4,791,214	36,419,579
Passengers.....number.....	21,966	34,419	56,385
Coal, hard.....net tons.....	477,683	36,961	514,644
Coal, soft.....do.....	4,695,618	580,908	5,276,526
Flour.....barrels.....	5,369,103	3,158,223	8,527,331
Wheat.....bushels.....	41,355,155	82,040,666	78,396,821
Grain, other than wheat.....do.....	24,472,337	7,239,291	31,711,628
Manufactured and pig iron.....net tons..	142,458	49,786	192,244
Salt.....barrels.....	277,676	136,643	414,319
Copper.....net tons.....	101,221	16,341	117,562
Iron ore.....do.....	21,583,831	2,326,630	23,910,461
Lumber.....M feet B. M.....	1,019,652	36,111	1,055,763
Silver ore.....net tons.....	1	-----	1
Building stone.....do.....	22,303	1,075	23,378
General merchandise.....do.....	475,464	239,076	714,540

NOTE.—The United States Canal was open to navigation 250 days during the fiscal year. The Canadian Canal was open to navigation 263 days during the fiscal year.

*Comparative statement of commerce through St. Marys Falls Canal, Michigan, for the fiscal years 1902 and 1903.*

	Fiscal year.		Increase.	Decrease.
	1902.	1903.		
Vessel passages.....number..	17,749	16,615	.....	1,134
Lockages.....do.....	9,417	9,140	.....	277
Tonnage, registered.....net tons..	26,077,256	26,557,413	.....	480,157
Tonnage, freight.....do.....	30,037,401	31,628,365	.....	1,590,964
Passengers.....number..	29,847	21,966	.....	7,881
Coal.....net tons..	4,611,860	5,173,301	.....	561,441
Flour.....barrels..	6,884,738	5,369,103	.....	1,515,635
Wheat.....bushels..	52,901,377	41,355,155	.....	11,546,222
Grain, other than wheat.....do....	21,969,065	24,472,337	.....	2,503,272
Manufactured and pig iron.....net tons..	170,775	142,458	.....	28,317
Salt.....barrels..	339,925	277,676	.....	62,249
Copper.....net tons..	98,763	101,221	.....	2,458
Iron ore.....do.....	19,960,226	21,583,831	.....	1,623,606
Lumber.....M feet B. M..	1,106,803	1,019,652	.....	87,151
Silver ore.....net tons..	.....	1	.....	1
Building stone.....do.....	50,536	22,303	.....	28,233
General merchandise.....do....	457,552	475,464	.....	17,912

*Summary of traffic through St. Marys Falls Canal, Michigan, for the fiscal year ending June 30, 1903.*

Number of vessels through Weitzel lock .....	6,009
Number of vessels through Poe lock .....	10,606
Number of lockages through Weitzel lock .....	3,934
Number of lockages through Poe lock .....	5,206
Total registered tonnage .....	26,557,413
Total freight tonnage .....	31,628,365
Total time spent in making lockages .....	4,569 hours 31 minutes
Average time spent in making a lockage .....	30 minutes
Total time spent by vessels in passing locks .....	8,297 hours 49 minutes
Average time spent by vessels in passing locks .....	29 minutes 58 seconds
Cost per lockage .....	\$9.17
Cost per passage .....	\$5.04
Cost per registered ton .....	3.16 mills
Cost per freight ton .....	2.65 mills

The Weitzel lock was open to navigation 220 days, from July 1 to December 2, 1902, and from April 27 to June 30, 1903.

The time for the Poe lock was 250 days, July 1 to December 16, 1902, and from April 11 to June 30, 1903.

Compared with the previous fiscal year, the commerce through St. Marys Falls Canal, Michigan, shows an increase in the following items: Registered tonnage, 2 per cent; freight tonnage, 5 per cent; coal, 12 per cent; grain, other than wheat, 11 per cent; copper, 2 per cent; iron ore, 8 per cent; general merchandise, 4 per cent. A decrease is shown in the following items: Vessel passages, 6 per cent; lockages, 3 per cent; passengers, 26 per cent; flour, 22 per cent; wheat, 22 per cent; manufactured and pig iron, 17 per cent; salt, 18 per cent; lumber, 8 per cent; building stone, 56 per cent.

In comparing the total traffic through the American and Canadian canals at Sault Ste. Marie, Mich., and Ontario, with the previous fiscal year, it shows an increase as follows: Registered tonnage, 7 per cent; freight tonnage, 10 per cent.

The total freight traffic of 36,419,579 tons is the largest in the history of the canals, and exceeds that of last year by 3,297,133 tons.

The canal post-office delivered 160,422 pieces of mail, consisting of 141,073 letters, 5,390 postals, 13,081 newspapers, 878 parcels. In addition to this, 1,013 pieces were returned to the city post-office after being held thirty days uncalled for, and 3,816 pieces were forwarded to new addresses.

The compilation of traffic statements was done by Clerks Frank T. McArthur and John McMahon.

Very respectfully, your obedient servant,

JOSEPH RIPLEY,  
Assistant Engineer and General Superintendent.

Maj. W. H. BIXBY,  
Corps of Engineers.

## 2016 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

STATISTICS OF LAKE COMMERCE PASSING THROUGH THE AMERICAN AND CANADIAN CANALS AT SAULT STE. MARIE, MICH., AND ONTARIO, DURING THE NAVIGATIONAL SEASON OF 1902.

[Compiled from official records at St. Marys Falls Canal, Michigan.]

### *Sources of information for traffic data and valuations.*

*Freight tonnage and passengers.*—The freight unit here used and designated as a "net ton" means in every instance a ton of 2,000 pounds, and is an entirely different unit from the "net or registered" ton of vessel registers, which merely measures 100 cubic feet of capacity. Except where specifically described as "registered" tons or "gross" tons, all tons mentioned in this report are "net" tons of 2,000 pounds each. The data relative to freight and passengers were compiled from reports made by vessel masters when passing through the American and Canadian canals. By a daily exchange of these reports with Supt. J. C. Boyd, of the Canadian canal, this office is enabled to list the entire lake traffic to and from Lake Superior.

*Registered tonnage and vessel valuations.*—The registered tonnage, as given, was obtained from vessel papers and blue books. Vessel valuations were obtained from Inland Lloyd's.

*Freight rates.*—These were compiled from quotations published in the Marine Review and Record, and from information obtained from shippers, owners, and carriers engaged in handling the several classes of lake commerce. The freight rates given are for lake transportation and include cost of loading and unloading.

*Freight valuations.*—The unit values used for the various items of freight were derived by taking the mean for the season of each monthly average as obtained from daily or weekly prices current.

The sources of the valuations given are as follows: Coal, quotations in Coal Trade Journal, at Duluth and Superior; cereals, Daily Commercial Record, published by Duluth Board of Trade; flour, daily quotations in Duluth, Superior, and Minneapolis journals; iron ore and pig iron, weekly quotations in Iron Trade Review, Marine Review-Record; salt, quotations at Lake Superior ports; copper, general merchandise, lumber, building stone, and manufactured iron, quotations by the principal shippers, owners, and carriers.

To quotations given at point of shipment, freight rates are added to lake ports of destination.

The compilation was done by the clerical force in the United States canal office at Sault Ste. Marie, Mich., under the general direction of Asst. Engineer and Supt. Joseph Ripley.

*American and Canadian canals.*—The total freight traffic of 35,961,146 net tons for the navigational season of 1902 is the maximum so far known for any one year in the history of the canals. It exceeds the traffic of the preceding year by 7,558,081 tons, or 27 per cent, such yearly gain being the largest yet known in amount, although not in percentage, and being 3,536,935 tons more than the previous largest yearly increase of 4,021,146 tons in 1899, and 12 per cent less than the 39 per cent yearly increase in 1886.

The increased tonnage was general for all the principal items of freight, with the exception of hard coal, manufactured iron, salt, and building stone.

The total number of passengers was 59,377; a decrease of 286 from season of 1901.

The season of navigation was the longest yet on record, and continued for a period of eight months and twenty days, during which time the average monthly traffic was 4,149,363 tons.

*American canal.*—The American canal passed 31,232,795 net tons of freight, being a yearly increase of 5,650,757 tons, or 22 per cent, and 22,778 passengers, a yearly decrease of 6,923, or 23 per cent, as compared with the season of 1901.

The American canal passed 87 per cent of the total freight and 38 per cent of the total number of passengers.

The American canal opened April 5 and closed December 16, 1902, making the length of its season 256 days.

*Canadian canal.*—The Canadian canal passed 4,728,351 net tons of freight, being a yearly increase of 1,907,324 tons, or 68 per cent, and 36,599 passengers, a yearly increase of 6,637, or 22 per cent, as compared with season of 1901.

The Canadian canal passed 13 per cent of the total freight and 62 per cent of the total number of passengers.

The Canadian canal was opened April 1 and closed December 20, 1902, making the length of its season 264 days.

Vessel passages through both canals numbered 22,659, showing a yearly gain of 2,618 passages, or 13 per cent, as compared with the 20,041 passages of 1901. The

total lockages numbered 12,846, showing a yearly gain of 1,525 lockages, or 13 per cent.

The 45 new vessels put in commission for the Lake Superior trade were large steam freighters, ranging from 225 to 436 feet in length, and designed for economical speed of 12 miles per hour on a draft of 19 to 21 feet.

The depth of water in entrance channels and through the canals and locks permitted a safe draft of 17½ to 19 feet.

The growth of the Lake Superior commerce during the past half century has been phenomenal. The estimated amount and value of articles which crossed the portage at Sault Ste. Marie in 1851, to and from Lake Superior, was 12,600 net tons, valued at \$1,675,000.

In 1861, a decade later, the traffic through the State locks was 88,000 net tons, valued at \$6,000,000.

In 1871, 585,000 net tons, valued at \$13,000,000.

In 1881, through the State and Weitzel locks, 1,567,741 net tons, at \$30,000,000.

In 1891, through Weitzel lock, 8,888,759 net tons, at \$128,178,208.

In 1901, through Weitzel, Poe, and Canadian locks, 28,403,065 net tons, at \$289,906,865.

Thus, the percentage of increase in tonnage of each year's traffic over that of the preceding year has averaged as follows:

	Per cent.
1851-1860 .....	21
1861-1870 .....	21
1871-1880 .....	10½
1881-1890 .....	19
1891-1900 .....	12½
Average, 1851-1900 .....	16½

*East and west bound commerce passing both American and Canadian canals at Sault Ste. Marie, Mich. and Ontario, for the season of 1902.*

## EAST BOUND.

Articles.	United States canal.	Canadian canal.	Total.
Copper .....	106,459	14,158	120,612
Grain .....	21,650,549	6,075,493	27,726,042
Building stone .....	37,064	1,855	38,919
Flour .....	6,072,295	2,837,710	8,910,005
Iron ore .....	21,796,348	2,481,207	24,277,555
Iron, pig .....	11,863	1,531	13,394
Lumber .....	1,028,848	62,623	1,091,471
Silver ore .....	1	—	1
Wheat .....	48,835,062	27,896,903	76,730,965
General merchandise .....	49,121	73,127	122,248
Passengers .....	10,869	19,897	30,766

## WEST BOUND.

Coal, hard .....	284,986	24,962	309,948
Coal, soft .....	8,973,448	529,082	9,502,530
Flour .....	—	235	235
Grain .....	60	14,720	14,780
Manufactured iron .....	142,803	41,965	184,768
Salt .....	283,410	159,896	443,306
General merchandise .....	456,489	162,368	617,852
Passengers .....	11,909	16,702	28,611
Freight—			
East bound .....	26,331,559	3,944,430	30,275,989
West bound .....	4,901,236	783,921	5,685,157
Total freight .....	31,232,795	4,728,351	35,961,146
Vessel passages .....	17,588	5,071	22,659
Registered tonnage .....	27,408,021	4,547,561	31,955,582

NOTE.—In addition to the above traffic, 6,500 cords pulp wood and 5,000,000 feet pine logs passed over the Rapids, bound for lower lake ports.  
(Net tons are tons of 2,000 pounds.)

# 2018 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

*Distribution of the above freight tonnage by calendar months during season of 1902.*

Month.	East bound.	West bound.	Total freight.
	<i>Net tons.</i>	<i>Net tons.</i>	<i>Net tons.</i>
April .....	1,952,550	886,684	2,839,234
May .....	3,632,885	792,774	4,425,659
June .....	3,944,004	777,604	4,721,608
July .....	4,357,545	724,853	5,082,398
August .....	4,276,304	794,187	5,070,491
September .....	3,983,556	689,976	4,673,532
October .....	4,028,083	590,208	4,618,291
November .....	3,465,418	667,620	4,133,038
December .....	635,644	261,251	896,895
<b>Total .....</b>	<b>30,275,989</b>	<b>5,685,157</b>	<b>35,961,146</b>

*Distribution of the above freight tonnage by lake ports from and to which the east and west bound freight was transported.*

EAST BOUND.		Net tons.
From Lake Superior ports to—		
Lake Michigan ports .....		3,334,952
Lake Huron ports .....		1,412,434
Lake Erie ports .....		25,247,132
Lake Ontario ports .....		261,471
<b>Total .....</b>		<b>30,275,989</b>
WEST BOUND.		
To Lake Superior ports from—		
Lake Michigan ports .....		104,027
Lake Huron ports .....		200,838
Lake Erie ports .....		5,346,410
Lake Ontario ports .....		33,882
<b>Total .....</b>		<b>5,685,157</b>

*Estimated value of total freight passing both American and Canadian canals at Sault Ste. Marie, Michigan and Ontario, for the season of 1902.*

Item.	Quantity.	Price per unit.	Valuation.
Coal, anthracite .....	net tons. 309,948	\$6.25	\$1,937,175
Coal, bituminous .....	do. 4,502,530	8.25	14,633,223
Flour .....	barrels. 8,910,240	8.50	\$1,186,840
Wheat .....	bushels. 76,730,965	.72	55,246,295
Grain, other than wheat .....	do. 27,740,822	.92	25,521,556
Manufactured iron .....	net tons. 184,758	110.00	20,323,380
Pig iron .....	do. 13,394	20.75	277,925
Salt .....	barrels. 443,306	.65	288,149
Copper (refined and matte) .....	net tons. 120,612	190.00	22,916,280
Iron ore .....	do. 24,277,555	8.10	75,260,420
Lumber .....	N feet B. M. 1,091,471	16.25	17,736,404
Sliver ore .....	net tons. 1	125.00	125
Building stone .....	do. 88,919	12.00	467,028
General merchandise .....	do. 740,100	125.00	92,512,500
<b>Total .....</b>			<b>358,306,300</b>

The value of grain, other than wheat, as given in the above table, is computed as follows:

Article.	Bushels.	Price per unit.	Total value.
Rye .....	1,217,211	\$0.51	\$620,777.61
Oats .....	3,836,188	.34	1,304,286.92
Corn .....	245,453	.65	159,544.45
Barley .....	6,140,890	.48	2,947,627.20
Flax .....	16,301,130	1.284	20,604,628.32
<b>Total .....</b>	<b>27,740,822</b>	<b>a .92</b>	<b>25,636,864.50</b>

a Average.

*Relative monetary value of freight (by class of commodities).*

	Per cent.
Coal (anthracite and bituminous).....	4.62
Cereals (wheat, rye, oats, corn, barley, flax, and flour).....	81.25
Iron (iron ore, manufactured and pig iron).....	26.75
Copper.....	6.40
Lumber.....	4.95
All other products.....	26.08
<b>Total.....</b>	<b>100.00</b>

*Freight charges upon freight transported through both American and Canadian canals at Sault Ste. Marie, Michigan and Ontario, for the season of 1902.*

Article.	Quantity.	Rate per unit.	Amount.
Coal.....net tons..	4,812,478	\$0.45	\$2,165,615.10
Flour.....barrels..	8,910,240	.12	1,069,228.80
Wheat.....bushels..	76,730,965	.019	1,457,888.33
Grain, other than wheat.....do.....	27,740,822	.019	527,075.82
Manufactured iron.....net tons..	184,758	2.00	369,516.00
Pig iron.....do.....	13,394	1.50	20,091.00
Salt.....barrels..	448,306	.15	66,495.90
Copper.....net tons..	120,612	1.40	168,856.80
Iron ore.....do.....	24,277,555	.68	16,508,737.40
Lumber.....M feet B. M..	1,091,471	2.45	2,674,108.95
Silver ore.....net tons..	1	2.00	2.00
Building stone.....do.....	88,919	1.50	58,878.50
General merchandise.....do.....	740,100	2.00	1,480,200.00
<b>Total.....</b>			<b>26,566,189.40</b>

*Classification of American and Canadian vessels, showing valuation and the tonnage and passengers carried by each of them through both the American and Canadian canals at Sault Ste. Marie, Michigan and Ontario, during season of 1902.*

## AMERICAN VESSELS.

[Net tons are tons of 2,000 pounds.]

Class.	No.	Valuation.	Tonnage.		Passen- gers.
			Registered.	Freight.	
Steamers.....	589	\$58,490,800	866,734	<i>Net tons.</i> 27,149,708	16,909
Sailing.....	262	8,714,200	272,641	7,198,036	
Unregistered.....				29,106	
<b>Total.....</b>	<b>851</b>	<b>67,205,000</b>	<b>1,139,375</b>	<b>84,376,850</b>	<b>16,909</b>

## CANADIAN VESSELS.

Steamers.....	67	\$3,208,100	36,383	1,815,360	42,468
Sailing.....	17	589,300	14,666	233,194	
Unregistered.....				35,742	
<b>Total.....</b>	<b>84</b>	<b>3,792,400</b>	<b>51,049</b>	<b>1,584,296</b>	<b>42,468</b>

American vessels carried 96 per cent of the total freight and 28 per cent of the total passengers.

Canadian vessels carried 4 per cent of the total freight and 72 per cent of the total passengers.

Unregistered American crafts carried 29,106 net tons of freight in 255 passages, or an average of 114  $\frac{114}{255}$  tons per passage.

Unregistered Canadian crafts carried 35,742 net tons of freight in 235 passages, or an average of 152  $\frac{152}{235}$  tons per passage.

Of the 22,659 passages for the season, 3,468 were by 90 vessels under 100 tons register, with an average register of 36 tons. The total freight carried by such craft amounted to 1,356 net tons.

# 2020 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

## Vessel dimensions.

Classification of registered vessels as to length and beam over all:

Length.	Beam.	Number of vessels.
30 to 100 feet.....	5 to 21 feet.....	84
100 to 200 feet.....	21 to 39 feet.....	248
200 to 300 feet.....	32 to 43 feet.....	837
300 to 400 feet.....	38 to 50 feet.....	179
400 to 500 feet.....	45 to 53 feet.....	87

## Maximum records.

Totals of the largest single cargoes carried by each boat when same exceeded 2,000 tons, arranged in successive gradations of each thousand net tons:

Class.	Number.	Maximum tonnage for one trip each.	
		Aggregate.	Average.
		<i>Net tons.</i>	<i>Net tons.</i>
Steamers carrying over—			
2,000 net tons.....	84	216,307	2,575
3,000 net tons.....	133	457,317	3,438
4,000 net tons.....	27	121,079	4,484
5,000 net tons.....	32	178,189	5,568
6,000 net tons.....	37	239,311	6,468
7,000 net tons.....	43	321,117	7,468
8,000 net tons.....	5	41,667	8,331
Sailing vessels carrying over—			
2,000 net tons.....	28	64,145	2,291
3,000 net tons.....	26	89,402	3,439
4,000 net tons.....	11	50,188	4,563
5,000 net tons.....	7	39,461	5,637
6,000 net tons.....	17	107,338	6,314
7,000 net tons.....	2	14,758	7,379
8,000 net tons.....	6	49,827	8,306
Total .....	458	1,990,096	.....

The above table shows that 458 different vessels in a single trip of each carried a total of 1,990,096 net tons.

## Individual maximum records made by vessels during the season.

Name of vessel.	Maximum.	Amount.	Owners.
Steamer Isaac L. Ellwood.....	Single cargo, net tons.....	8,441	Pittsburg Steamship Co.
Barge John Smeaton.....	.....do.....	8,485	Do.
Steamer Wm. Edenborn.....	Total cargoes, net tons.....	183,270	Do.
Steamer Troy.....	Miles run.....	45,340	New York Central and Hudson R. R. Co.
Steamer Wm. Edenborn.....	Mile-tons.....	158,858,138	Pittsburg Steamship Co.

The maximum traffic for a single day was on August 14, when 253,370 freight tons were passed through the canals by 127 vessels, whose registered tonnage amounted to 197,633 tons.

The minimum traffic for a single day was on December 17, when no freight passed through the canals, although 4 vessels were locked through, whose registered tonnage amounted to 12 tons.

## Delays.

The American canal records show that vessels necessarily spent 26,197 hours and 31 minutes in canal, or an average of 1 hour 29 minutes and 22 seconds, which includes time waiting for lockage and passage through locks and canal, the latter being 1½ miles long. Other delays at canal, which included taking on supplies, waiting for daylight or favorable weather, amounted to 22,000 hours and 10 minutes.

A blockade was caused by displacement of railway swing bridge, the schooner *Maderia* in tow of the steamer *Douglass Houghton*, striking the south end of the bridge when it was swung across the canal, and moving it about 6 feet lengthwise on central pier. The canal was delayed 110 hours and 58 minutes between June 5 and 10, while swing bridge was being centered and swung clear of canal.

Other delays to boats due to operating railway swing bridge amounted to 59 minutes. Trains were delayed 15 hours and 56 minutes by passing boats, temporarily preventing the closing of bridge.



*General summary—For American and Canadian canals together.*

[All tons are net tons of 2,000 pounds.]

Total .....	mile-tons ..	29, 755, 916, 637
Total freight carried .....	tons ..	35, 961, 146
Total valuation placed on freight carried .....		\$358, 306, 300
Average value per ton of freight carried .....		\$9.96
Total amount paid for freight transportation .....		\$26, 566, 189.40
Average distance freight was carried .....	miles ..	827.4
Cost per mile per ton .....	mills ..	.89
Average cost per ton for freight transportation .....		\$0.74
Total number of registered vessels using canals .....		935
Total number of passages by unregistered crafts carrying freight ..		490
Time American canal was operated .....	days ..	256
Time Canadian canal was operated .....	do ..	264
Total valuation placed on registered vessels .....		\$70, 997, 400
Total number of passengers transported .....		59, 377
Freight carried by—		
Registered vessels .....	tons ..	35, 896, 298
Unregistered vessels .....	do ..	64, 848
American vessels .....	per cent ..	96
Canadian vessels .....	do ..	4
Passengers carried by—		
American vessels .....	do ..	28
Canadian vessels .....	do ..	72

*Canal post-office.*

The American canal post-office delivered 162,684 pieces of mail during the season, consisting of 144,368 letters, 5,424 postals, 12,057 newspapers, and 835 parcels; also returned 1,097 pieces to the city post-office after being held thirty days uncalled for, and forwarded 3,839 pieces to new addresses. This shows an increase over the previous year of 44,414 pieces of mail. The carrying, distributing, and delivering of marine mail was done by the office employees in addition to their regular duties of receiving masters' reports and keeping the traffic records.

*Comparative traffic—Years 1901 and 1902.*

Lake commerce through both the American and Canadian canals at Sault Ste. Marie, Michigan and Ontario, for the seasons of 1901 and 1902:

[Tons of 2,000 pounds.]

Items.	Traffic for 1902.		Total traffic for—		Gain, 1902.		Loss, 1902.	
	United States canal.	Canadian canal.	Season 1902.	Season 1901.	Amount.	Per cent.	Amount.	Per cent.
Vessel passages:								
Steamers .....	12, 738	4, 331	17, 069	14, 372	2, 697	19		
Sailing .....	3, 927	441	4, 368	4, 482			114	3
Unregistered .....	923	299	1, 222	1, 187	35	3		
Total .....	17, 588	5, 071	22, 659	20, 041	2, 618			
Lockages .....	9, 427	3, 419	12, 846	11, 321	1, 525	13		
Tonnage:								
Registered .....	27, 408, 021	4, 547, 561	31, 955, 582	24, 626, 976	7, 328, 606	30		
Freight .....	31, 232, 795	4, 728, 351	35, 961, 146	28, 403, 065	7, 558, 081	27		
Passengers .....	22, 778	36, 599	59, 377	59, 663			286	
Coal:								
Hard .....	284, 966	24, 962	309, 918	804, 493			494, 545	61
Soft .....	3, 973, 448	529, 082	4, 502, 530	3, 788, 643	713, 887	19		
Flour .....	6, 072, 295	2, 837, 945	8, 910, 240	7, 634, 340	1, 275, 900	17		
Wheat .....	48, 885, 062	27, 895, 903	76, 780, 965	52, 812, 636	23, 918, 329	45		
Grain other than wheat, bushels ..	21, 660, 609	6, 090, 213	27, 740, 822	21, 760, 547	2, 980, 275	12		
Manufactured and pig iron, tons ..	154, 666	43, 486	198, 152	206, 443			8, 291	4
Salt .....	283, 410	159, 896	443, 306	443, 774			468	
Copper .....	106, 459	14, 153	120, 612	98, 601	22, 011	22		
Iron ore .....	21, 796, 348	2, 481, 207	24, 277, 555	18, 090, 618	6, 186, 937	34		
Lumber .....	1, 028, 848	62, 623	1, 091, 471	1, 072, 124	19, 347	2		
Silver ore .....	1		1		1			
Building stone .....	37, 064	1, 855	38, 919	46, 584			7, 665	16
General merchandise .....	504, 610	235, 490	740, 100	558, 041	182, 059	33		

# 2022 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

## Comparative yearly summaries for the seasons 1887 to 1902.

Total freight, its valuation, freight charges, average haul or distance freight was carried, and rate per ton per mile, for seasons 1887 to 1902:

[All tons are net tons of 2,000 pounds.]

Year.	Total freight.	Valuation of freight.	Freight charges.	Average haul.	Freight charges, per mile ton.	Value of American craft.	Value of Canadian craft.
	<i>Tons.</i>			<i>Miles.</i>	<i>Mills.</i>		
1887.....	5,494,649	\$79,081,757	\$10,075,153	811.4	2.3	\$17,684,550	\$2,089,400
1888.....	6,411,223	82,156,019	7,883,077	806.4	1.5	20,381,100	1,514,300
1889.....	7,516,022	83,732,527	8,634,246	790.4	1.5	25,328,600	1,597,600
1890.....	9,041,213	102,214,948	9,472,214	797.2	1.3	27,857,700	1,777,800
1891.....	8,888,759	123,178,206	9,849,022	820.4	1.35	31,947,300	2,119,500
1892.....	11,214,333	135,117,267	12,072,850	822.4	1.31	36,220,100	2,108,700
1893.....	10,796,572	145,436,957	9,957,483	831.9	1.1	39,017,400	2,115,700
1894.....	13,195,860	143,114,502	10,798,310	821.1	.99	41,124,200	1,959,800
1895.....	15,062,840	159,575,129	14,238,758	830.0	1.14	40,858,800	2,037,000
1896.....	16,239,061	193,146,842	13,511,615	836.4	.99	43,006,200	2,135,300
1897.....	18,982,755	218,235,927	13,220,099	841.3	.83	42,375,700	2,001,400
1898.....	21,234,664	233,069,740	14,125,896	842.6	.79	45,199,800	2,491,900
1899.....	25,255,310	281,364,750	21,959,707	827.2	1.05	65,000,520	3,369,600
1900.....	25,643,073	267,041,959	24,953,314	825.9	1.18	66,116,583	3,618,576
1901.....	28,403,065	289,406,865	23,217,974	823.3	.99	57,244,200	3,311,900
1902.....	35,961,146	358,406,300	26,566,189	827.4	.89	67,205,000	3,792,400

## Freight rates for water transportation to and from Lake Superior.

[Tons of 2,000 pounds.]

Items.	1887.	1888.	1889.	1890.	1891.	1892.	1893.	1894.
Coal.....ton..	\$0.90	\$0.70	\$0.47	\$0.45	\$0.43	\$0.41	\$0.40	\$0.40
Flour.....barrel..	.29	.17	.18	.13	.15	.16	.17	.14
Wheat.....bushel..	.07	.08	.04	.03	.04	.03	.02	.02
Grain.....do....	.07	.04	.03	.02	.03	.03	.02	.02
Manufactured iron.....ton..	2.35	1.80	2.10	1.34	2.50	2.15	2.00	.90
Pig iron.....do....	2.35	1.80	1.45	1.35	1.17	1.23	1.30	1.15
Salt.....barrel..	.18	.16	.18	.15	.13	.15	.12	.12
Copper.....ton..	2.60	2.35	2.25	2.38	2.00	1.40	1.75	1.95
Iron ore.....do....	1.75	1.28	1.14	1.10	.98	1.00	.80	.70
Lumber.....M ft. B. M..	4.00	2.80	2.70	2.88	2.70	2.95	2.55	1.90
Silver ore.....ton..	3.00	1.90	1.90	2.25	2.25	2.25	2.25	2.25
Building stone.....do....	1.15	2.05	2.02	2.00	2.00	1.67	1.85	1.28
Unclassified freight.....do....	4.00	3.00	3.00	2.75	3.58	3.60	3.00	2.75

Items.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.
Coal.....ton..	\$0.37	\$0.32	\$0.30	\$0.25	\$0.46	\$0.44	\$0.38	\$0.45
Flour.....barrel..	.14	.11	.10	.10	.13	.12	.12	.12
Wheat.....bushel..	.044	.02	.017	.02	.036	.02	.023	.019
Grain.....do....	.045	.02	.02	.02	.036	.02	.022	.019
Manufactured iron.....ton..	1.50	1.40	1.40	1.40	1.70	2.00	2.00	2.00
Pig iron.....do....	1.05	1.05	1.05	1.05	1.50	1.50	1.50	1.50
Salt.....barrel..	.13	.15	.15	.15	.15	.15	.15	.15
Copper.....ton..	1.66	1.95	1.95	2.00	2.00	1.60	1.65	1.40
Iron ore.....do....	.82	.65	.60	.60	.70	1.06	.78	.68
Lumber.....M ft. B. M..	2.00	1.80	1.55	1.65	3.00	2.30	2.55	2.45
Silver ore.....ton..	2.33	2.33	2.33	.....	2.50	2.00	.....	2.00
Building stone.....do....	1.20	1.50	1.50	1.50	2.00	1.50	1.50	1.50
Unclassified freight.....do....	2.50	2.30	2.30	2.40	2.50	2.00	2.25	2.00

## 2023

*Values of total freight carried, by class of commodities, for the seasons 1887 to 1902.*

Items.	1887.	1888.	1889.	1890.	1891.
Coal (hard and soft) .....	\$4, 735, 454	\$7, 867, 644	\$5, 702, 190	\$7, 619, 288	\$8, 776, 862
Flour .....	7, 863, 675	10, 583, 625	11, 143, 535	16, 195, 520	18, 900, 715
Wheat .....	22, 634, 590	18, 224, 424	16, 907, 217	16, 893, 022	38, 040, 239
Grain (other than wheat) .....	759, 653	1, 981, 862	2, 090, 580	2, 003, 496	1, 011, 462
Manufactured iron .....	8, 035, 750	2, 442, 350	1, 677, 250	4, 680, 750	2, 128, 000
Pig iron .....	241, 468	252, 348	442, 272	886, 104	462, 077
Salt .....	204, 908	210, 433	168, 250	179, 431	234, 528
Copper .....	6, 977, 200	5, 792, 000	6, 691, 200	8, 745, 800	18, 838, 000
Iron ore .....	8, 741, 998	8, 996, 608	14, 535, 492	16, 711, 686	12, 460, 744
Lumber .....	2, 974, 638	4, 326, 636	5, 679, 972	6, 514, 722	6, 593, 400
Silver ore and bullion .....	53, 326	520, 579	914, 589	527, 807	266, 211
Building stone .....	124, 010	835, 410	335, 880	479, 730	240, 800
Unclassified freight .....	20, 675, 160	20, 751, 240	18, 744, 600	22, 277, 640	25, 025, 580
<b>Total .....</b>	<b>79, 031, 757</b>	<b>82, 156, 019</b>	<b>83, 782, 527</b>	<b>102, 214, 948</b>	<b>128, 178, 208</b>

Items.	1892.	1893.	1894.	1895.	1896.
Coal (hard and soft) .....	\$10,164,981	\$10,528,420	\$8,191,917	\$6,993,351	\$8,452,078
Flour .....	21,672,540	29,682,696	33,621,649	33,883,682	34,199,008
Wheat .....	80,746,085	82,611,239	22,816,469	90,041,863	47,442,847
Grain (other than wheat) .....	833,346	1,846,998	772,504	4,164,847	10,704,748
Manufactured iron .....	2,983,600	2,852,800	1,805,350	3,683,150	4,696,200
Pig iron .....	709,716	505,902	531,452	346,788	577,286
Salt .....	275,740	228,730	237,461	202,439	178,186
Copper .....	12,998,600	17,506,000	19,814,000	21,490,400	23,374,400
Iron ore .....	17,153,962	14,050,946	17,027,078	22,382,519	25,705,062
Lumber .....	9,231,192	10,568,810	11,564,508	8,889,400	8,562,325
Silver ore and bullion .....	296,815	379,861	456,144	11,200	26,890
Building stone .....	396,980	194,260	214,170	238,760	177,810
Unclassified freight .....	27,648,760	24,910,800	27,071,100	27,798,480	81,251,060
<b>Total .....</b>	<b>135,117,267</b>	<b>145,436,957</b>	<b>143,114,502</b>	<b>159,575,129</b>	<b>195,146,842</b>

Items.	1897.	1898.	1899.	1900.	1901.	1902.
Coal (hard and soft).....	\$9,456,824	\$10,334,461	\$12,854,278	\$14,620,840	\$15,492,226	\$16,570,398
Flour.....	40,145,144	38,066,688	25,610,929	27,042,752	24,811,687	31,185,840
Wheat.....	48,654,148	49,871,997	43,798,001	28,842,511	86,440,719	56,246,296
Grain (other than wheat).....	11,449,256	13,039,192	17,700,552	14,071,953	22,779,708	26,521,556
Manufactured iron.....	6,092,400	10,709,360	19,111,000	11,551,000	17,609,800	20,322,380
Pig iron.....	176,437	476,776	457,762	851,518	486,520	277,925
Salt.....	214,086	426,170	227,252	328,836	382,530	298,148
Copper.....	24,464,800	29,616,240	38,428,000	39,213,800	26,227,866	22,916,220
Iron ore.....	31,901,145	35,120,880	52,116,016	61,663,380	58,794,509	75,260,220
Lumber.....	10,875,762	12,964,582	17,646,969	15,008,241	16,617,922	17,736,104
Silver ore and bullion.....	560		60,875	13,750		1,126
Building stone.....	62,490	46,700	468,758	586,824	559,008	467,028
Unclassified freight.....	84,742,880	37,388,760	52,873,560	54,139,700	69,755,125	92,512,500
<b>Total.....</b>	<b>218,235,927</b>	<b>238,069,740</b>	<b>281,364,750</b>	<b>267,041,969</b>	<b>289,906,865</b>	<b>358,806,300</b>

*Values of freight carried per unit of each class, for the seasons 1887 to 1902.*

[Tons of 2,000 pounds.]

[illegible]

# 2024 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

*Values of freight carried per unit of each class, for the seasons 1887 to 1902—Continued.*

Items.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.
Coal, anthracite.....ton..	\$4.25	\$4.75	\$5.50	\$4.75	\$5.70	\$5.25	\$5.60	\$6.25
Coal, bituminous.....do...	2.40	2.50	2.60	2.40	2.60	3.00	2.90	3.25
Flour.....barrel...	3.75	3.85	4.50	4.25	3.60	4.00	3.25	3.50
Wheat.....bu-hel...	.65	.75	.87	.80	.75	.70	.69	.72
Grain, (other than wheat).....do...	.50	.39	.46	.50	.69	.87	.92	.92
Manufactured iron.....ton...	50.00	50.00	50.00	50.00	100.00	100.00	100.00	110.00
Pig iron.....do...	13.00	13.50	13.25	13.25	19.50	17.50	16.00	20.75
Salt.....barrel...	.75	.75	.75	.75	.75	1.00	.75	.65
Copper.....ton...	200.00	200.00	200.00	240.00	320.00	300.00	265.00	190.00
Iron ore.....do...	2.77	3.25	3.00	3.00	3.40	3.75	3.25	3.10
Lumber.....M ft. B. M.	12.00	12.50	13.50	14.50	17.00	16.50	15.50	16.25
Silver ore.....ton...	112.00	112.00	112.00	.....	125.00	125.00	.....	125.00
Building stone.....do...	10.00	10.00	10.00	10.00	12.00	12.00	12.00	12.00
General merchandise.....do...	60.00	60.00	60.00	60.00	90.00	100.00	125.00	125.00

## HISTORICAL NOTES.

The fall in St. Marys Rapids varies from 16½ to 20½ feet.

The first lock was built on the Canadian side of the river by the Hudson Bay Fur Company in 1798. It was 38 feet long, 8 feet 9 inches wide, with a lift of 9 feet. A towpath was made along the shore for oxen to pull the bateaux and canoes through the upper part of the rapids. This lock, excepting its timber floor and miter sills, was destroyed in 1814 by United States troops from Mackinaw Island under command of Major Holmes.

The next locks were built on the American side of the river by the State of Michigan in 1853 to 1855, and such locks and canal are generally spoken of as the State Canal; and 750,000 acres of land in Michigan was granted by Congress for their construction. The canal was 1½ miles long, 64 feet wide at bottom, 100 feet wide at water surface, and 13 feet deep. There were two tandem locks of masonry, each 350 by 70 feet by 11½ feet on the miter sills, with a lift of about 9 feet each. Charles T. Harvey was superintendent of construction and the St. Marys Falls Ship Canal Company was the contractor. The locks were destroyed in 1888 to make room for the present Poe lock.

The Weitzel lock, 515 feet long, 80 feet wide in chamber, narrowing to 60 feet at the gates, with 17 feet of water on the miter sills at mean stage, was built by the United States in the years 1870 to 1881. The canal depth was then increased to 16 feet below its water surface, and its average width was increased to 160 feet, and the stone slope walls were replaced with timber piers having a vertical face. Gen. Godfrey G. Weitzel was the engineer officer in charge of the district from 1872 to 1882, and Alfred Noble was the assistant engineer in local charge from 1870 to 1882. Boyle & Roach were the principal contractors.

The Canadian canal, 1½ miles long, 150 feet wide and 22 feet deep, with lock 900 feet long, 60 feet wide, having 22 feet on the miter sills, was built on the north side of the river between the years 1888 and 1895. Hon. Collingwood Schreiber was chief engineer of Dominion canals, etc., and W. G. McNeill Thompson was the Government engineer in local charge of construction work. Ryan & Haney were the contractors.

The Poe lock, 800 feet long, 100 feet wide, and having 22 feet of water on the sills, was built by the United States in the years 1887 to 1896. Gen. Orlando M. Poe was the engineer officer in charge of the district from 1884 to 1895, and E. S. Wheeler the assistant engineer in local charge of construction work from 1882 to 1897. Hughes Brothers & Bangs were the principal contractors.

The American canal since its first construction has been deepened to 25 feet, and its entrance piers have been extended so that the total length is now 1½ miles. Its width is variable, being 500 feet at the upper entrance, 108 feet at the movable dam, 270 feet at the basin above locks, and 1,000 feet at the lower entrance. Dunbar & Sullivan and James B. Donnelly were the principal contractors.

The channel through St. Marys River has gradually been improved through shoals of sand, clay, boulders, sandstone rock, and limestone rock so as to now have a least depth of 20 feet at mean stage of water over a least width of 300 feet.

The approximate cost in round numbers of the several improvements is as follows:

Locks and canal of 1855.....	\$1, 000, 000
Weitzel lock .....	1, 000, 000
Poe lock .....	3, 000, 000
Widening and deepening canal.....	3, 000, 000
Improving channel through river.....	3, 000, 000
Canadian lock, canal, and approaches.....	4, 000, 000

Hydraulic power is used for operating the American locks; a pressure of 115 pounds per square inch being used for the Weitzel lock machinery and a pressure of 380 pounds for the Poe lock machinery. Electricity generated by water power is used for operating the Canadian lock.

The Poe lock can be filled or emptied in about seven minutes, and an uplockage of a boat 350 feet long has been made in as short an interval as eleven minutes. The gates can be operated or closed in two and one-fourth minutes, although three to five minutes are usually taken. The Weitzel lock can be operated in about the same time as the Poe lock. The Canadian lock can be operated in about nine minutes.

*Statement of commerce through both American and Canadian canals at Sault Ste. Marie, Michigan and Ontario, for each season or calendar year from their opening in 1855.*

## TONNAGE AND CLASS OF VESSELS.

Year.	Date of opening canal.	Date of closing canal.	Sailing vessels.	Steamers.	Unregistered craft.	Total passages.	Registered tonnage.
1855.....	June 18	Nov. 23	44	149	.....	193	106, 296
1856.....	May 4	Nov. 28	112	178	.....	290	101, 458
1857.....	May 9	Nov. 30	192	184	.....	376	180, 820
1858.....	Apr. 18	Nov. 20	182	224	.....	406	219, 819
1859.....	May 3	Nov. 28	411	258	.....	669	352, 642
1860.....	May 11	Nov. 26	579	337	.....	916	408, 657
1861.....	May 3	Nov. 14	242	296	.....	538	276, 639
1862.....	Apr. 27	Nov. 27	543	295	.....	838	359, 612
1863.....	Apr. 28	Nov. 24	952	305	.....	1, 257	507, 434
1864.....	May 2	Dec. 4	1, 045	366	.....	1, 411	571, 438
1865.....	May 1	Dec. 3	602	395	.....	997	409, 062
1866.....	May 5	do	555	453	.....	1, 008	458, 530
1867.....	May 4	do	839	466	.....	1, 305	556, 899
1868.....	May 2	do	817	338	.....	1, 155	432, 563
1869.....	May 4	Nov. 29	989	399	.....	1, 388	524, 885
1870.....	Apr. 29	Dec. 1	1, 397	431	.....	1, 828	690, 826
1871.....	May 8	Nov. 29	1, 064	573	.....	1, 637	752, 101
1872.....	May 11	Nov. 26	1, 212	792	.....	2, 004	914, 735
1873.....	May 5	Nov. 18	1, 519	968	.....	2, 517	1, 204, 446
1874.....	May 12	Dec. 2	833	901	.....	1, 734	1, 070, 857
1875.....	do	do	569	1, 464	.....	2, 033	1, 259, 534
1876.....	May 8	Nov. 26	684	1, 733	.....	2, 417	1, 541, 676
1877.....	May 2	Nov. 30	1, 401	1, 050	.....	2, 451	1, 439, 216
1878.....	Apr. 8	Dec. 3	1, 091	1, 476	.....	2, 567	1, 667, 136
1879.....	May 2	do	1, 403	1, 618	100	3, 121	1, 677, 071
1880.....	Apr. 28	Nov. 15	1, 718	1, 735	50	3, 503	1, 734, 890
1881.....	May 7	Dec. 5	1, 706	2, 117	181	4, 004	2, 092, 757
1882.....	Apr. 21	Dec. 8	1, 663	2, 739	872	4, 774	2, 468, 068
1883.....	May 2	Dec. 11	1, 458	2, 620	237	4, 315	2, 042, 259
1884.....	Apr. 23	Dec. 10	1, 709	3, 609	371	5, 689	2, 997, 837
1885.....	May 6	Dec. 2	1, 689	3, 354	337	5, 380	3, 085, 937
1886.....	Apr. 26	Dec. 4	2, 534	4, 584	306	7, 424	4, 219, 397
1887.....	May 1	Dec. 2	2, 562	5, 968	825	9, 355	4, 897, 598
1888.....	May 7	Dec. 4	2, 009	5, 305	489	7, 803	5, 130, 659
1889.....	Apr. 15	do	2, 635	6, 501	443	9, 579	7, 221, 935
1890.....	Apr. 20	Dec. 3	2, 872	7, 268	417	10, 557	8, 454, 425
1891.....	Apr. 27	Dec. 7	2, 405	7, 339	447	10, 191	8, 400, 685
1892.....	Apr. 18	Dec. 6	3, 324	8, 737	519	12, 580	10, 647, 203
1893.....	May 1	Dec. 5	2, 955	8, 379	674	12, 008	8, 949, 754
1894.....	Apr. 17	Dec. 6	3, 678	10, 208	607	14, 491	13, 110, 366
1895.....	Apr. 25	Dec. 11	4, 790	12, 496	671	17, 956	16, 806, 781
1896.....	Apr. 21	Dec. 8	4, 391	13, 404	820	18, 615	17, 249, 418
1897.....	do	Dec. 14	4, 438	12, 029	704	17, 171	17, 619, 933
1898.....	Apr. 11	do	4, 449	12, 461	851	17, 761	18, 622, 754
1899.....	Apr. 26	Dec. 20	4, 778	14, 378	1, 101	20, 255	21, 958, 847
1900.....	Apr. 19	Dec. 16	4, 004	14, 426	1, 022	19, 452	22, 315, 834
1901.....	Apr. 20	Dec. 21	4, 482	14, 372	1, 187	20, 041	24, 626, 976
1902.....	Apr. 1	Dec. 20	4, 368	17, 069	1, 222	22, 659	31, 955, 582

# 2026 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

Statement of commerce through both American and Canadian canals at Sault Ste. Marie, Michigan and Ontario, etc.—Continued.

## PASSENGER AND FREIGHT TRAFFIC.

[Tons of 2,000 pounds.]

Year.	Date of opening canal.	Date of closing canal.	Passen- gers.	Coal.	Flour.	Wheat.	Grain, other than wheat.	Manufac- tured and pig iron.	Salt.
			Number.	Tons.	Barrels.	Bushels.	Bushels.	Tons.	Barrels.
1855..	June 18	Nov. 23	8,295	1,414	10,289			1,445	196
1856..	May 4	Nov. 23	7,992	3,968	17,686		82,060	2,272	1,027
1857..	May 9	Nov. 30	6,650	5,298	18,515		40,637	4,426	1,118
1858..	Apr. 18	Nov. 20	9,230	4,118	13,782		21,000	8,081	1,223
1859..	May 3	Nov. 28		8,884	39,459	74	71,738	7,172	2,737
1860..	May 11	Nov. 26			50,230		133,437	1,446	
1861..	May 3	Nov. 14	8,816	11,507	22,743	223	76,830	4,904	3,014
1862..	Apr. 27	Nov. 27	8,463	11,346	17,291		59,062	7,023	2,477
1863..	Apr. 28	Nov. 24	18,281	7,805	31,975		78,480	7,989	1,506
1864..	May 2	Dec. 4	16,985	11,282	33,937		143,560	9,234	1,776
1865..	May 1	Dec. 3	19,777		34,985			7,400	3,175
1866..	May 5	do	14,067	19,915	33,603		229,926	14,484	4,454
1867..	May 4	do	15,120	22,927	28,345		249,031	23,141	5,316
1868..	May 2	do	10,590	25,814	27,372		285,123	23,991	4,624
1869..	May 4	Nov. 29	17,657	27,850	32,007		323,501	25,604	5,910
1870..	Apr. 29	Dec. 1	17,153	15,952	33,548	49,700	304,077	42,049	11,069
1871..	May 8	Nov. 29	15,859	46,798	26,060	1,376,705	308,823	57,216	36,199
1872..	May 11	Nov. 26	25,830	80,815	136,411	567,134	445,774	100,293	42,690
1873..	May 5	Nov. 18	30,968	96,780	172,692	2,119,997	909,645	47,996	29,335
1874..	May 12	Dec. 2	22,958	61,124	179,855	1,120,015	149,999	33,713	44,231
1875..	do	do	19,685	101,260	309,991	1,213,788	272,580	56,649	43,989
1876..	May 8	Nov. 26	20,286	124,960	390,577	1,971,549	424,468	67,409	46,666
1877..	May 2	Nov. 30	21,800	91,575	355,117	1,319,738	378,063	42,705	63,188
1878..	Apr. 8	Dec. 3	20,394	91,856	344,599	1,872,940	264,674	18,116	63,520
1879..	May 2	do	18,979	110,704	451,154	2,603,666	973,948	43,771	92,245
1880..	Apr. 28	Nov. 15	25,766	170,501	523,860	2,105,920	2,563,436	54,302	77,916
1881..	May 7	Dec. 5	24,671	295,647	605,453	3,456,965	367,538	87,830	65,997
1882..	Apr. 21	Dec. 3	29,256	430,184	344,044	3,728,856	473,129	92,870	176,612
1883..	May 2	Dec. 11	39,130	714,444	687,031	5,900,473	776,552	109,910	70,898
1884..	Apr. 23	Dec. 10	54,214	706,379	1,248,243	11,985,791	517,103	72,428	144,804
1885..	May 6	Dec. 2	36,147	894,991	1,440,093	15,274,213	422,981	60,842	136,355
1886..	Apr. 25	Dec. 4	27,088	1,009,999	1,759,365	18,991,485	715,373	115,208	158,677
1887..	May 1	Dec. 2	32,668	1,352,987	1,572,735	23,096,520	775,166	74,919	204,908
1888..	May 7	Dec. 4	25,558	2,105,041	2,190,725	18,596,351	2,022,308	63,703	210,433
1889..	Apr. 15	do	25,712	1,629,197	2,228,707	16,217,370	2,135,245	57,661	168,250
1890..	Apr. 20	Dec. 3	24,856	2,176,925	3,239,104	16,217,370	2,044,384	116,327	179,431
1891..	Apr. 27	Dec. 7	26,190	2,507,532	3,780,143	38,816,570	1,032,104	69,741	234,628
1892..	Apr. 18	Dec. 6	25,890	2,904,266	5,418,135	40,994,780	1,666,690	101,520	275,740
1893..	May 1	Dec. 5	18,869	3,008,120	7,420,674	43,481,652	2,405,344	89,452	286,449
1894..	Apr. 17	Dec. 6	27,236	2,797,184	8,965,773	34,869,483	1,545,008	60,659	237,461
1895..	Apr. 25	Dec. 11	31,656	2,574,362	8,902,302	46,218,250	8,328,694	100,337	267,919
1896..	Apr. 21	Dec. 8	37,066	3,023,340	8,882,858	63,256,463	14,478,071	121,872	237,515
1897..	do	Dec. 14	40,213	3,039,172	8,921,143	55,924,302	24,589,688	135,164	285,449
1898..	Apr. 1	do	43,426	3,776,450	7,778,043	62,339,996	26,078,384	250,170	301,560
1899..	Apr. 26	Dec. 16	49,082	3,940,887	7,114,147	58,397,335	30,000,935	214,585	316,336
1900..	Apr. 19	Dec. 16	58,555	4,486,977	6,760,688	40,489,302	16,174,669	338,585	328,895
1901..	Apr. 20	Dec. 21	59,663	4,593,136	7,634,350	52,812,636	24,760,547	206,443	443,774
1902..	Apr. 1	Dec. 20	59,377	4,812,478	8,910,240	76,730,965	27,740,822	196,162	443,306

Year.	Date of opening canal.	Date of closing canal.	Copper.	Iron ore.	Lumber.	Silver ore and bullion.	Building stone.	Unclassi- fied freight.	Total Freight.
			Tons.	Tons.	M feet B. M.	Tons.	Tons.	Tons.	Tons.
1855..	June 18	Nov. 23	3,196	1,447	127			5,690	14,503
1856..	May 4	Nov. 23	5,977	11,597	433			5,538	33,817
1857..	May 9	Nov. 30	4,400	26,185	680			7,140	51,607
1858..	Apr. 18	Nov. 20	6,944	31,035	188			9,587	57,002
1859..	May 3	Nov. 28	7,269	65,769	766			25,280	122,066
1860..	May 11	Nov. 26	9,000	120,000				14,915	153,721
1861..	May 3	Nov. 14	7,645	44,837	661			12,972	87,847
1862..	Apr. 27	Nov. 27	6,881	113,014	210			19,355	161,675
1863..	Apr. 28	Nov. 24	1,044	181,567	1,414			30,213	236,780
1864..	May 2	Dec. 4	5,331	213,753	2,012			33,477	284,350
1865..	May 1	Dec. 3	9,935	147,459	822			11,226	181,638
1866..	May 5	do	9,550	152,102	660			32,310	239,457
1867..	May 4	do	10,585	222,861	1,177			33,632	325,367
1868..	May 2	do	12,222	191,939	1,404			31,843	299,175
1869..	May 4	Nov. 29	18,662	239,368	1,423			41,813	368,826
1870..	Apr. 29	Dec. 1	11,301	401,850	814	92	4,590	40,342	639,883
1871..	May 8	Nov. 29	14,562	327,461	1,098	464	5,528	74,227	585,583
1872..	May 11	Nov. 26	14,986	383,105	1,553	306	5,213	109,663	746,258
1873..	May 5	Nov. 18	15,947	504,121	2,191	580	2,218	123,396	888,432
1874..	May 12	Dec. 2	15,345	427,658	686	413	401	55,812	665,186

*Statement of commerce through both American and Canadian canals at Sault Ste. Marie, Michigan and Ontario, etc.—Continued.*

Year.	Date of opening canal.	Date of closing canal.	Copper.	Iron ore.	Lumber.	Silver ore and bullion.	Building stone.	Unclassified freight.	Total freight.
			<i>Tons.</i>	<i>Tons.</i>	<i>M feet B. M.</i>	<i>Tons.</i>	<i>Tons.</i>	<i>Tons.</i>	<i>Tons.</i>
1875..	May 12	Dec. 2	18,396	493,406	4,498	847	2,978	70,128	833,465
1876..	May 8	Nov. 26	25,756	609,752	17,820	965	2,102	91,119	1,073,570
1877..	May 2	Nov. 30	16,767	568,082	15,373	1,020	2,506	64,201	912,639
1878..	Apr. 8	Dec. 3	22,529	555,750	34,889	768	2,754	60,007	937,351
1879..	May 2	....do....	22,309	540,075	43,439	324	2,226	81,279	1,050,784
1880..	Apr. 28	Nov. 15	21,753	677,073	48,635	66	2,283	100,849	1,321,906
1881..	May 7	Dec. 5	29,488	748,131	58,877	-----	1,400	129,031	1,567,741
1882..	Apr. 21	Dec. 3	25,409	987,060	82,783	22	5,428	172,167	2,029,521
1883..	May 2	Dec. 11	31,024	791,732	87,131	814	2,405	191,571	2,267,105
1884..	Apr. 23	Dec. 10	36,062	1,136,071	122,389	9,731	6,047	207,173	2,874,557
1885..	May 6	Dec. 2	31,927	1,235,122	127,984	3,669	8,189	184,963	3,256,628
1886..	Apr. 26	Dec. 4	38,627	2,087,809	138,688	2,009	9,449	230,726	4,527,759
1887..	May 1	Dec. 2	34,886	2,497,713	165,226	350	13,401	344,586	5,494,649
1888..	May 7	Dec. 4	28,960	2,570,517	240,372	3,385	33,541	345,854	6,411,423
1889..	Apr. 15	....do....	33,456	4,095,855	315,551	5,947	33,538	312,410	7,516,022
1890..	Apr. 20	Dec. 3	43,729	4,774,768	361,929	3,432	47,973	371,294	9,041,213
1891..	Apr. 27	Dec. 7	69,190	3,560,213	366,305	1,731	44,080	417,093	8,888,759
1892..	Apr. 18	Dec. 6	64,993	4,901,132	512,844	1,930	39,698	459,146	11,214,333
1893..	May 1	Dec. 5	87,530	4,014,556	588,545	2,470	19,426	415,180	10,796,572
1894..	Apr. 17	Dec. 6	99,573	6,548,876	722,788	412	21,417	451,185	13,195,860
1895..	Apr. 26	Dec. 11	107,402	8,062,209	710,700	100	23,876	463,308	15,062,580
1896..	Apr. 21	Dec. 8	116,872	7,909,250	684,986	240	17,731	520,851	16,239,061
1897..	....do....	Dec. 14	122,324	10,633,715	805,612	5	6,249	579,048	18,982,755
1898..	Apr. 11	....do....	124,226	11,706,960	895,485	-----	4,670	623,146	21,234,644
1899..	Apr. 26	Dec. 20	120,090	15,328,240	1,038,057	487	39,063	587,484	25,255,810
1900..	Apr. 19	Dec. 16	131,066	16,443,568	909,651	110	48,902	641,397	25,643,073
1901..	Apr. 20	Dec. 21	98,601	18,090,618	1,072,124	-----	46,584	558,041	28,403,065
1902..	Apr. 1	Dec. 20	120,612	24,277,555	1,091,471	1	38,919	740,100	35,961,146

St. Marys Falls Canal, Michigan, State Lock, 1855 to 1887.

St. Marys Falls Canal, Michigan, Weitzel Lock, since September 1, 1881.

St. Marys Falls Canal, Michigan, Poe Lock, since August 3, 1896.

Sault Ste. Marie Canal, Ontario, Canadian Lock, since September 9, 1895.

#### Q Q 4.

#### IMPROVEMENT OF HAY LAKE AND NEEBISH CHANNELS, ST. MARYS RIVER, MICHIGAN.

This improvement was commenced in 1883 and opened to navigation June 7, 1894. The result was a new line of travel through the St. Marys River, 11 miles shorter and 4 feet deeper than that previously available, and one which can be navigated at night with a reasonable degree of safety. The width of channel was 300 feet and the general navigable depth 20 feet; but the first step in the work had been in rock cutting through the Middle Neebish section, and there the bottom grade was about 2 feet higher than in the other parts of the improvement. Work since 1895 has been applied to increasing the width of channel at critical points, to the removal of some isolated shoals that have been discovered in the meantime, and to making the depth through the Middle Neebish section equal to that of the other portions of the improved channel.

At the beginning of the last fiscal year the dredged portion of the Hay Lake channel was about 10 miles long, 5 of which has a width of 300 feet and the remaining 5 a width of from 450 to 1,100 feet. The depth was 20 feet in soft-bottom sections and 21 feet where rock or stone exists.

The river and harbor act of June 13, 1902, contained provisions authorizing the completion to 20 feet available depth and 800 feet minimum width of the present channel from Lake Superior to the head of the St. Marys Falls Canal, and from the foot of such canal to the foot of Hay Lake, and a channel of like depth and 300 feet minimum width from Hay Lake through the Middle Neebish and Little Mud Lake to Mud Lake, and a channel of like depth and of 800 feet minimum width from Mud Lake to Lake Huron; and, further, the commencement and prosecution of work upon a second channel of like depth and 300 feet minimum width from Hay Lake through the West Neebish to Mud Lake, so as to finally provide a 300-foot minimum width of channel way from Lake Superior to the head of the St. Marys Falls Canal and from the foot of such canal to Lake Huron for descending boats and an additional 300 feet width for ascending boats, partly in a single channel of 600 feet width and partly in two channels, each of 300 feet width. The total expenditures to June 30, 1903, are \$2,594,994.32,<sup>a</sup> leaving \$1,364,120.68 available for further payment.

Operations of the present fiscal year were as follows:

Dredging was carried on under five contracts, by which (1) 142,558 cubic yards, scow measurement, of hard mixed material was removed by Contractor Hickler from the Little Rapids between July 1 and December 6, 1902, continued between April 6 and June 30, 1903 (to be finished about September, 1903); (2) 1,048,585 cubic yards, scow measurement, of soft mixed material was removed by Contractor Dixon from another part of the Little Rapids between July 1 and November 12, 1902; (3) 716,612 cubic yards, scow measurement, of soft mixed material was removed by Contractor Simono from a third part of the Little Rapids between July 1 and December 6, 1902, continued between April 20 and June 30, 1903 (to be finished in 1903); (4) 132,332 cubic yards, scow measurement, of clay, sand, and silt was removed by Contractor Dixon from a narrow test cut along the center or side of the new channel at the foot of Hay Lake between November 18 and December 6, 1902, continued between April 23 and June 27, 1903; (5) 64,677 cubic yards, scow measurement, of sand, clay, and silt was removed by contractor, Lake Erie Dredging Company, from a similar cut along the new channel at the head of West Neebish, and 50 cubic yards of bowlders from Bayfield shoal between November 24 and December 1, 1902, continued between April 24 and June 30, 1903.

Surveys through the ice were made over the dredged areas in February and March, 1903. Special surveys and lines of levels were run along and across the newly proposed West Neebish route.

Preparations were made toward advertising the new work of the 1902 act through Hay Lake and both Neebish routes.

The details of the above work were carried out under the local charge of Assistant Engineer Benno Rohnert and the general supervision of Assistant Engineer Joseph Ripley, whose report is attached in full explanation of its detail.

The contracts now in progress for increasing the width of channel in the Little Rapids section from 300 to 600 feet, in accordance with project submitted May 18, 1900, and approved June 28, 1900, will complete this old work, and no further funds are now considered neces-

<sup>a</sup> Repayments amounting to \$142.47 have been deducted from the total expenditures, as explained below the list of appropriations.



sary therefor. For the due progress of the new work provided for by the June 13, 1902, river and harbor act an appropriation of \$500,000 will be needed in 1904 under the sundry civil act.

Reports as to the full cost of the new work will be submitted to Congress at its next session.

*Money statement.*

July 1, 1902, balance unexpended .....	\$841, 660. 51
Amount appropriated by sundry civil act approved March 3, 1903 .....	800, 000. 00
	<hr/>
	1, 641, 660. 51
June 30, 1903, amount expended during fiscal year .....	<sup>a</sup> 277, 539. 83
	<hr/>
July 1, 1903, balance unexpended .....	1, 364, 120. 68
July 1, 1903, outstanding liabilities .....	19, 618. 51
	<hr/>
July 1, 1903, balance available .....	1, 344, 502. 17
	<hr/>
July 1, 1903, amount covered by uncompleted contracts .....	30, 574. 34
	<hr/>
{ Amount (estimated) required for completion of existing project .....	3, 200, 000. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1905, in addition to the balance unexpended July 1, 1903 .....	500, 000. 00
{ Submitted in compliance with requirements of sundry civil act of June 4, 1897.	

APPROPRIATIONS.

*Hay Lake channel.*

August 2, 1882 .....	\$200, 000
July 5, 1884 .....	125, 000
August 5, 1886 .....	150, 000
August 11, 1888 .....	500, 000
September 19, 1890 .....	400, 000
March 3, 1891 (sundry civil act) .....	300, 000
August 5, 1892 (sundry civil act) .....	115, 000
March 3, 1893 (sundry civil act) .....	225, 000
August 18, 1894 (sundry civil act) .....	150, 000
March 3, 1899 .....	100, 000
June 6, 1900 (sundry civil act) .....	250, 000
June 28, 1902 (sundry civil act) .....	144, 115

*Middle and West Neebish channels.*

June 13, 1902 .....	500, 000
March 3, 1903 (sundry civil act) .....	800, 000
	<hr/>
Total .....	3, 959, 115

The following repayments of amounts expended are omitted from the appropriation list, to the footing of which they have heretofore been improperly added, and the total (\$142.47) deducted from the total expenditures:

Receipts from sales of fuel to officers between March, 1883, and March, 1887 .....	\$124 90
Repayment of disallowance, voucher 9, November, 1885 (see p. 2245, Report of Chief of Engineers, 1887) .....	6. 75
Repayment of disallowance, part of voucher 8, August, 1894 (see p. 3052, Report of Chief of Engineers, 1895) .....	10. 82
	<hr/>
Total .....	142. 47

<sup>a</sup> Includes \$11.90 paid by Treasury Department, account Michigan Central Railroad Company.

## 2030 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

### ABSTRACT OF CONTRACTS IN FORCE DURING THE FISCAL YEAR ENDING JUNE 30, 1903.

#### *Contract dated September 16, 1901, for dredging section 1, Hay Lake channel.*

Name of contractor: Henry Hickler, Sault Ste. Marie, Mich.  
 Rates: \$0.56 per cubic yard, bank measurement (full rate), and \$0.28 per cubic yard, bank measurement (half rate).  
 Date of approval: September 30, 1901.  
 Date of beginning work: October 12, 1901.  
 Date of expiration: October 31, 1903.

#### *Contract dated September 17, 1901, for dredging section 2, Hay Lake channel.*

Name of contractor: Samuel O. Dixon, Milwaukee, Wis.  
 Rates: 11.4 cents per cubic yard, bank measurement (full rate), and 5.7 cents per cubic yard bank measurement (half rate).  
 Date of approval: September 30, 1901.  
 Date of beginning work: October 12, 1901.  
 Date of expiration: October 31, 1903; completed November 12, 1902.

#### *Contract dated June 5, 1902, for dredging section 3, Hay Lake channel.*

Name of contractor: Charles Simono, Two Rivers, Wis.  
 Rates: 12 cents per cubic yard, bank measurement (full rate), and 6 cents per cubic yard, bank measurement (half rate).  
 Date of approval: June 28, 1902.  
 Date of beginning work: About August 15, 1902.  
 Date of expiration: About June 2, 1904.

#### *Emergency contract dated November 7, 1902, for time work by dredging plant in Neebish channels.*

Name of contractor: The Lake Erie Dredging Company, Buffalo, N. Y.  
 Rates: \$17.50 per working hour.  
 Date of beginning work: November 24, 1902.  
 Date of expiration: About November 2, 1903.

#### *Emergency contract dated November 7, 1902, for time work by dredging plant in Neebish channels.*

Name of contractor: Samuel O. Dixon, Milwaukee, Wis.  
 Rate: \$18 per working hour.  
 Date of beginning work: November 18, 1902.  
 Date of expiration: About October 20, 1903.

### COMMERCIAL STATISTICS.

*Table showing extent and growth of commerce through Hay Lake channel, as derived from official records of St. Marys Falls canals, Michigan and Ontario.*

Season of navigation.	Freight.	Valuation.	Passengers.
1894.....	13, 195, 860	\$143, 114, 502	27, 236
1895.....	15, 062, 580	159, 575, 129	31, 656
1896.....	16, 239, 061	195, 146, 842	87, 066
1897.....	18, 982, 755	218, 235, 927	40, 213
1898.....	21, 234, 664	233, 069, 739	43, 426
1899.....	25, 255, 810	281, 364, 750	51, 060
1900.....	25, 643, 073	267, 041, 959	58, 555
1901.....	28, 408, 065	289, 906, 865	59, 663
1902.....	35, 961, 146	358, 306, 300	59, 877

REPORTS OF MR. JOSEPH RIPLEY, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,  
*Sault Ste. Marie, Mich., July 1, 1903.*

MAJOR: I have the honor to submit the following report of operations for improving Hay Lake channel during the fiscal year ending June 30, 1903:

## SECTION 1. WIDENING AT LITTLE RAPIDS.

Improving upper entrance to Hay Lake to a width of 600 feet, to a depth of 21 feet below low-water stage 580.2, and for a length of 3,850 feet. Contract dated September 16, 1901; Henry Hickler, of Sault Ste. Marie, Mich., contractor. Rates: 56 cents per cubic yard to 21-foot grade, and 28 cents per cubic yard, bank measurement, between 21 and 22 foot grades. Material: Sand, clay, stones, boulders, and hardpan.

Dredging operations were begun September 23, 1901. During the past year 4 dredges and 2 derrick boats have been variously employed. Dredging was discontinued for the winter season from December 6 to April 6.

The dredges worked 4,292.9 hours and were delayed 825.6 hours by breakages and other causes. The derrick boats worked 956 hours, lost by delays 252.7 hours, and raised 2,083 cubic yards of boulders. The excavated material amounted to 142,558 cubic yards, scow measurement, and was deposited in dumping ground near Bayfield range lights at head of Sugar Island. The east half of channel, 300 feet wide, was opened to navigation on August 26, when the west 300 feet was closed. The limits of the channel were plainly marked with 15 spar buoys and 8 float lights, which were placed as aids to navigation. An additional area 500 feet wide, extending from the angle upstream, was opened on November 28. This section will be finished in September.

## SECTION 2. WIDENING OF 300-FOOT CHANNEL THROUGH THE LITTLE RAPIDS 300 FEET TO EASTWARD TO A DEPTH OF 21 FEET BELOW LOW-WATER STAGE OF 579.0 FEET AND FOR A LENGTH OF 5,750 FEET.

Contract dated September 17, 1901; Samuel O. Dixon of Milwaukee, Wis., contractor. Rates: 11.4 cents per cubic yard, bank measurement, to 21-foot grade, and 5.7 cents per cubic yard, bank measurement, between 21 and 22 foot grades. Material: Sand, clay, gravel, and stones. Contractor began work October 8, 1901, and completed same November 12, 1902.

Excavation during fiscal year was carried on by four dredges. They worked 3,193 $\frac{1}{2}$  hours, were delayed by breakages and other causes 1,535 $\frac{1}{2}$  hours, and removed 1,048,585 cubic yards, scow measure. At intervals during October and November, 1902, a heavy drag was towed over the section to level off the high points above 21-foot grade.

For all dredges operated while contract was in force, the total number of hours worked was 5,294 $\frac{1}{2}$ ; hours delayed, 2,660 $\frac{1}{2}$ , and the total yardage, scow measure, was 1,784,685. After three tests with the suspended raft bars, the section was finally found clear at the specified grade and accepted on November 12, on which day the entire section was thrown open to navigation.

The computations for final estimate were made in duplicate and from soundings taken for this purpose in February, 1903. The computed bank measure of material excavated was 1,537,257.1 cubic yards above 21-foot grade plane, 62,420.2 cubic yards between 21 and 22 foot grade planes, and 181,195.0 cubic yards below 22-foot grade plane and outside of side slopes, making a total of 1,780,872.2 cubic yards. The total excavation by scow measurement exceeded the total computed bank measurement by one-fifth of 1 per cent. The total computed bank measurement above 21-foot grade was 86.1 per cent of the total scow measure. The percentages of the total excavation for the different kinds of material are approximately: 93 of clay, 4 of sand, 2 of gravel, and 1 of small stones and boulders. The material was dumped in two grounds, the one north of the Partridge Point range target and the other in Wasig Bay, Hay Lake. The cost of excavation was \$178,805.26, exclusive of engineering and office expenses.

## SECTION 3. WIDENING OF 450-FOOT CHANNEL BELOW ISLANDS AT LITTLE RAPIDS AN ADDITIONAL 150 FEET TO THE EASTWARD TO A DEPTH OF 21 FEET BELOW LOW-WATER STAGE OF 579.5 FEET FOR A LENGTH OF 10,200 FEET.

Contract dated June 5, 1902; Charles Simono, of Two Rivers, Wis., contractor. Rates: 12 cents per cubic yard, bank measurement, to 21-foot grade, and 6 cents per cubic yard between 21 and 22 feet. Material: Clay, sand, gravel, and stones.

## 2032 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

Work was first begun on June 17, 1902. During the past year two dredges have been continuously employed, except during the winter intermission, December 6 to April 20. The hours worked were 3,246 $\frac{1}{2}$  and delayed 500 $\frac{1}{2}$ . The excavation amounted to 716,612 cubic yards, and the dumping ground was in Wasig Bay, head of Hay Lake.

There were 21 stakes and 5 gauge boards placed for use of the contractors.

### SURVEYS.

An lve survey was made covering the entire Little Rapids channel and the Nine-Mile Point Shoal in Hay Lake. A three-auger party was employed February 14 to March 14 in taking 62,667 soundings. About one-half of the soundings have been mapped and also plotted on cross-section sheets. Part of them were used in computing season's estimate of sections 1 and 2 and amount of material to be removed in order to deepen remainder of present channel to 21 feet at low water.

Examination with raft bars was made of sections 1 and 2 of Nine-Mile Point Shoal and of the Middle Neebish rock section. A rock found above grade in the Middle Neebish was removed by the diver.

Two days of simultaneous readings were taken in December at 6 gauges along Little Rapids to determine slope of river after widening channel through the islands.

A report was submitted in August on completing past projects by expenditure of available balance of funds heretofore appropriated.

The tugs *Antelope* and *Myra* were inspected in August by the steamboat inspectors, Charles M. York and Charles M. Gooding, and they condemned the tug *Myra*.

Assistant Engineer Benno Rohnert had special charge of the Hay Lake work.

Very respectfully, your obedient servant,

JOSEPH RIPLEY, *Assistant Engineer.*

Maj. W. H. BIXBY,  
*Corps of Engineers.*

### UNITED STATES ENGINEER OFFICE,

*Sault Ste. Marie, Mich., July 1, 1903.*

MAJOR: I have the honor to submit the following report of operations for improving Middle and West Neebish channels during the fiscal year ending June 30, 1903:

A survey was made in July, 1902, of the rapids part of sailing course 6 of the West Neebish route by taking 13,489 levels 10 by 10 feet apart. The soundings were mapped on tracing linen and also plotted on the cross section sheets. Four new triangulation stations were established along shores of rapids and new tripods built at three of the old stations.

The map of the 1873 survey was modified so as to show location of channel and the soundings corrected to extreme low-water stage of 579.2 at head and 578.8 at foot of rapids.

A project for improving the Middle and West Neebish channels, with estimates of time and cost of making the improvements, was submitted in August. Specifications were prepared for dredging a tug channel about 5 miles long across flats foot of Hay Lake and for excavating a channel 300 feet wide and 22 feet deep through the limestone rock section, sailing course 6, West Neebish channel.

A list was made of the coordinates of all stakes required for marking side lines of courses 4 to 8.

### FLATS HAY LAKE ENTRANCE TO WEST NEEBISH.

Channel 30 feet wide and 14 feet deep low stage of water, with test pits 25 feet deep every 500 feet.

Under emergency contract dated November 7, 1902, Samuel O. Dixon, of Milwaukee, Wis. furnished his dredge No 8, tug *Knapp*, and two dump scows, at the rate of \$18 per working hour. Operations were begun November 18, 1902; the winter intermission lasted from December 6 to April 23, and by June 27, 1903, a dredge cut had been made along center line of course 4, between cross sections 100 and 243, and alongside line of course 5 between cross sections 0 and 80, a distance of 12,185 feet. There were 132,332 cubic yards, scow measurement, of clay, sand, and silt removed and deposited near  $\Delta$  20 on east shore of Hay Lake during the 739.1 hours worked.

Under the emergency contract dated November 7, 1902, the Lake Erie Dredging Company furnished their elevator dredge, tug *Fred A. Lee*, and 2 dump scows, at the rate of \$17.50 per working hour. Dredging operations were begun November 24, 1902,

and discontinued for the winter from December 1 to April 24. The cut has been carried along east channel line of course 5, between cross sections 80 and 193, a distance of 5,650 feet. There were 64,677 cubic yards of sand, clay, and silt removed during the 591.5 working hours. As the original depth of water was only 3 to 6 feet, it was impracticable to load into scows, so the material was deposited about 60 feet east of the cut.

There were 71 stakes driven on east line of channel, 12 flag buoys, and 8 gauge boards placed for use of the contractors.

Dredge No. 8 was towed to Sault Ste. Marie on June 27, 1903, and worked five hours on test cut on Bayfield shoal. Fifty cubic yards of bowlders were excavated.

A scow 26 feet wide, 83 feet long, and 6 feet deep, costing \$1,700, was built for the quarters boat *Hay Lake*.

Assistant Engineer Benno Rohnert had immediate charge of the West Neebish surveys and dredging.

Very respectfully, your obedient servant,

JOSEPH RIPLEY, *Assistant Engineer*.

Maj. W. H. BIXBY,  
*Corps of Engineers.*

## Q Q 5.

### IMPROVEMENT OF ST. CLAIR FLATS CANAL, MICHIGAN.

The history of this improvement to June 30, 1896, is outlined in the Report of the Chief of Engineers for that year, pages 2881-2889, no work having been done from 1896 up to 1901, inclusive, the then existing projects having been completed.

The river and harbor act of June 13, 1902, contained new provisions to authorize the construction of a second channel, similar to the one already in use and parallel to it but separated therefrom by a dike of about 100 feet width, so as to provide a channel of 20 feet minimum depth and about 300 feet width from Lake St. Clair up into St. Clair River for ascending boats and a similar channel for descending boats.

The total expenditures under new projects up to June 30, 1903, amount to \$1,884.12, leaving \$330,275.27 still available for further work.

The work of the past year has been confined to surveys and other minor work preliminary to contracts for excavation of the new channel-way.

The general supervision of this work and the preparation of new projects have been under the charge of Principal Assistant Engineer E. S. Wheeler.

It is now estimated that about \$85,000 will have to be taken from the St. Marys River funds as above provided for, but that with this assistance the funds (\$415,275.27) now available will probably be sufficient to complete the approved work, and therefore no further appropriation is required at present.

#### *Money statement.*

July 1, 1902, balance unexpended .....	\$332, 159. 39
June 30, 1903, amount expended during fiscal year .....	1, 884. 12
July 1, 1903, balance unexpended .....	\$330, 275. 27
Amount (estimated) required for completion of existing project .....	(a)

<sup>a</sup>This does not include, however, the \$85,000 (estimated) diverted from the appropriation for improving St. Marys River at the Falls by act of June 13, 1902.

# 2034 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

## APPROPRIATIONS.

June 23, 1866 .....	\$80,000	March 3, 1879 .....	\$3,000
March 2, 1867 .....	150,000	June 14, 1880 .....	2,500
July 25, 1868 .....	86,000	August 5, 1886 .....	18,750
April 10, 1869 .....	142,560	August 11, 1888 .....	75,000
July 11, 1870 .....	16,500	September 19, 1890 .....	80,000
March 3, 1871 .....	1,500	June 13, 1902 .....	330,000
June 10, 1872 .....	4,000		
March 3, 1873 .....	100,000	Total .....	1,094,810
June 18, 1878 .....	5,000		

NOTE.—The appropriations of 1852, \$20,000, and 1856, \$45,000, are not taken account of, for the reason that they did not enter into the improvement of St. Clair Flats Canal, the first having been expended in building a dredge and the second in dredging the north channel of the South Pass. From March 3, 1881, the amounts allotted for operating and care of St. Clair Flats Canal are rendered separately.

## REPORT OF MR. E. S. WHEELER, ASSISTANT ENGINEER.

ENGINEER OFFICE, U. S. ARMY,  
Detroit, Mich., July 8, 1903.

MAJOR: I have the honor to make the following report of operations under my charge connected with the improvement of the St. Clair Flats Canal during the fiscal year ending June 30, 1903.

Borings have been made in the site of the proposed new channel to show the character of the material. The borings were made in two lines, one on the east side and one on the west side of the proposed new channel. The lines of borings were 350 feet apart, and the borings 200 feet apart. There were 104 holes in all. The borings were carried down at least 3 feet below the proposed grade.

The material is clay and sand in the proportions of one of clay to three of sand. Specimens of the different materials were preserved. This work was done during the months of August and September, 1902.

Specifications and drawings for the improvement at the Flats have been prepared.

Very respectfully,

E. S. WHEELER, *Assistant Engineer.*

Maj. W. H. BIXBY,  
*Corps of Engineers.*

## Q Q 6.

### OPERATING AND CARE OF ST. CLAIR FLATS CANAL, MICHIGAN.

During the last fiscal year the routine work of watching traffic through the canal and reading water gauges was carried on as usual. The pile revetment of dikes was slightly damaged on several occasions by passing vessels, and the necessary repairs were made. Other repairs were made, such as replacing 600 linear feet of timber revetment, etc.

Preparations were made for construction of office building, boat-house, telephone line, etc.

Careful compilations and reductions from the records of the Detroit marine post-office and the Detroit and Windsor custom-houses for the calendar year 1902 show results as follows:

St. Clair Flats Canal:

Net registered tonnage of vessels passing through St. Clair Flats Canal. 37, 119, 245  
Freight carried by such vessels in tons of 2,000 pounds each..... 41, 773, 998

The above statistics, although still somewhat approximate, are considered to be the most complete compilation yet made for this waterway, and the method of its preparation, as given by the report of Assistant Engineer E. S. Wheeler, dated May 4, 1903, is appended to report for Detroit River for use of other persons engaged in compiling and comparing similar statistics.

The general supervision of this work has been under charge of Principal Assistant Engineer E. S. Wheeler.

*Summary of expenses for operating and care of St. Clair Flats Canal, Michigan, for the fiscal year ending June 30, 1903.*

Pay rolls (routine operation and care) .....	\$1,953.33
Contingencies (routine operation and care) .....	553.36
Repairs of dikes and piers (balance of 1898 approved project) .....	3,139.16
Supervision and contingencies (balance of 1898 approved project) .....	330.00
	<hr/>
	5,975.85

*Money statement.*

Expenses to June 30, 1902 .....	\$87,093.56
Expended during fiscal year ending June 30, 1903 .....	\$3,912.11
Outstanding liabilities to June 30, 1903 .....	330.86
Amount covered by existing contract .....	1,732.88
	<hr/>
	5,975.85
Total expenses to June 30, 1903 (including outstanding liabilities and contract obligations) .....	93,069.41

*Expenses for operating and care of St. Clair Flats Canal, Michigan.*

1882 .....	\$8,786.69	1894 .....	\$3,592.18
1883 .....	5,668.87	1895 .....	1,993.32
1884 .....	2,532.15	1896 .....	2,501.57
1885 .....	4,906.59	1897 .....	2,162.81
1886 .....	9,539.11	1898 .....	2,099.65
1887 .....	1,819.53	1899 .....	2,399.78
1888 .....	1,510.00	1900 .....	3,348.15
1889 .....	20,315.00	1901 .....	3,053.23
1890 .....	2,158.16	1902 .....	2,121.97
1891 .....	2,020.20	1903 .....	5,975.85
1892 .....	1,888.67		<hr/>
1893 .....	2,675.93	Total .....	93,069.41

*Estimate.*

Amount (estimated) for fiscal year ending June 30, 1904 .....	\$42,000
Balance from allotment for preceding year (in round numbers) .....	39,500
	<hr/>
Additional allotment required for fiscal year ending June 30, 1904 .....	2,500

*Statement of receipts and expenses for fiscal year ending June 30, 1903.*

<b>Receipts:</b>	
Balance at close of fiscal year ending June 30, 1902 .....	\$34,637.84
Allotment July 29, 1902 .....	11,000.00
	<hr/>
	45,637.84
<b>Expenses</b> .....	5,975.85
	<hr/>
Balance at close of fiscal year ending June 30, 1903 .....	39,661.99

2036 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

CONTRACT IN FORCE.

*Emergency contract, dated May 9, 1903, for furnishing hemlock lumber.*

Name of contractor: Chas. W. Kotcher, Detroit, Mich.

Rate: \$17 per M feet, B. M.

Date of beginning work: May 19, 1903.

Date of expiration: About September 19, 1903.

---

REPORT OF MR. E. S. WHEELER, ASSISTANT ENGINEER.

ENGINEER OFFICE, U. S. ARMY,  
*Detroit, Mich., July 9, 1903.*

MAJOR: I have the honor to submit the following report of operations under my charge connected with the operating and care of St. Clair Flats Canal for the fiscal year ending June 30, 1903:

The canal has been under the immediate charge of Custodian William Mott, with one assistant. Mr. Mott reports that the piers and dikes have been slightly injured three times by passing vessels; these injuries have all been repaired and the cost borne by the several vessels causing the injury.

The heights of the spars of some of the vessels passing the canal have been determined instrumentally by Mr. Mott. There were in all 265 vessels measured. The greatest height of spars above water surface of the 265 that were measured was 130 feet; there were 71 of the 265 that had a height of more than 100 feet.

The amount of commerce passing through St. Clair Flats Canal was carefully determined. The method was as follows:

A record of all the boats passing Detroit was obtained from the Detroit marine post-office. A record of all the boats passing the canal which stopped in Detroit and Windsor was obtained from the Detroit and Windsor customs offices. The net registered tonnage of all these vessels was then taken from the American and Canadian "blue book;" this gives with considerable accuracy the total net registered tonnage passing the canal. The actual freight carried was then calculated by multiplying the net registered tonnage by the ratio between net registered tonnage and actual freight carried, as found at St. Marys Falls Canal for the season of 1902. This gave the actual freight, in tons of 2,000 pounds each, which passed St. Clair Flats Canal during the season of 1902 as 41,773,998 tons.

Preliminary plans and estimates for an office building and boathouse have been prepared and submitted.

Some repairs to the east dike have been made with hired labor under the direction of the custodian during the months of May and June, 1903. Six hundred linear feet of sheet piling, double thickness, was driven along the east side of the east dike, and 500 cubic yards of earth was placed in the dike.

During the year the custodian has inspected passing vessels, reported infractions of rules, etc., in the usual manner.

Very respectfully,

E. S. WHEELER, *Assistant Engineer.*

Maj. W. H. BIXBY,  
*Corps of Engineers.*

---

Q Q 7.

IMPROVEMENT OF DETROIT RIVER, MICHIGAN.

This improvement was commenced in 1874 under a project for excavating a channel through a reef of limestone bed rock, known as the Lime Kiln Crossing, to give a winding channel of 20 feet depth over 300 feet width; and operations have been continued since that time, resulting in the removal of the principal obstructions to navigation in the main channel of the river from its mouth to the foot of Fighting Island, a distance of about 12 miles. The work has consisted mainly in the removal of bed rock and extensive boulder shoals, over which the safe navigable depth before improvement varied from 12½ to 15 feet at mean stage of water. As a result of the work done to June 30,



1902, the safe navigable depth at mean stage was increased to 18½ feet at the shoalest parts of the channel, and to depths of from 19 to 21 feet through most of the distance. The width of the improved channel varies from 250 to 800 feet.

The river and harbor act of March 3, 1899, authorized expenditures for this improvement to the extent of \$661,500, all of which has been since appropriated under the sundry civil acts of June 6, 1900, March 3, 1901, and June 28, 1902.

The river and harbor act of June 13, 1902, contained new provisions to authorize the completion of a channel 21 feet, minimum low-water depth, over 600 feet minimum width from Lake St. Clair through Detroit River to Lake Erie.

Since the report of May 29, 1900 (Plan A), was submitted the rates of labor have increased, and it is quite possible that the total cost of this work will eventually reach that of the higher estimate, \$2,000,000, mentioned in the 1900 report, but as the work already provided for, as above, will require several years, during which the lake levels may change considerably, making new estimates again necessary, no increase of authorities is required at present.

The total expenditures up to June 30, 1903, amount to \$1,513,782.80,<sup>a</sup> leaving \$990,717.20 still available for further payments.

Operations inaugurated under the continuing-contract system, as described in the Report of the Chief of Engineers for 1900, pages 3997-4001, were continued throughout the year, as follows:

Drilling, blasting, and dredging were carried on under six contracts, by which (1) 10,998 cubic yards above the 21-foot grade, 4,000 cubic yards between the 21 and 23 foot grades, and 12,682 cubic yards below the 23-foot grade (for which no payments were allowable), all of limestone bed rock, was removed by Contractor Donnelly from Lime Kiln Crossing between July 1 and November 26, 1902, continued between May 6 and June 30, 1903; (2) 2,396 cubic yards above the 22-foot grade, 1,537 cubic yards between the 22 and 23 foot grades, and 3,105 cubic yards below the 23-foot grade (no payment allowable), all of limestone bed rock, bowlders, and other heavy material was removed by the Buffalo Dredging Company from Ballard reef channel between July 1 and November 18, 1902, when work was completed; (3) 37,798 cubic yards above the 22-foot grade and 55,898 cubic yards below the 22-foot grade (no payment allowable), all of limestone bed rock, bowlders, and other heavy material was removed by Contractor Sullivan from Amherstburg reach between July 1 and December 13, 1902, continued between March 20 and June 30, 1903; (4) 3,257 cubic yards of bowlders and heavy material above the 22-foot grade and 3,570 cubic yards between the 22 and 23-foot grades, and 6,653 cubic yards below the 23-foot grade (for which no payments were allowable), was removed by Contractor Sullivan from the upper end of Amherstburg reach between July 1 and October 21, 1902, when the work was completed; (5) 3,630 cubic yards above the 22-foot grade, 1,850 cubic yards between the 22 and 23 foot grades, and 1,488 below the 23-foot grade (for which no payments were allowable) was removed by the Donnelly Contracting Company from the south end of Lime Kiln Crossing between July 7 and November 22, 1902; (6) 67,250 cubic yards, scow measurement, of heavy material, mainly above the 21-foot grade,

<sup>a</sup> Repayments amounting to \$110.41 have been deducted from the total expenditures, as explained below the list of appropriations.

was removed by Contractors Breymann & Bro. (by time work), from the upper end of Amherstburg reach and upper end of Hackett's range between July 1 and October 2, 1902, all this work being to secure depths as specified below a Lake Erie stage of 572.6 feet above mean tide at New York for the old contracts and below a 571.5-foot grade for contracts of 1902.

The removal from the channel of isolated bowlders to the extent of about 370 cubic yards was done by a hired-labor party between May 1 and June 30, 1903. A new scow was built during the year for use in such work.

Surveys by sweeping raft in summer and through ice in winter were continued quite steadily all through the year by hired-labor parties for inspection of completed work and to serve as basis of final computations of finished contract work. Special surveys of similar character were made over portions of the back river and side channels near Wyandotte as a preliminary to improvement of the Wyandotte approaches, as specially authorized by the 1902 appropriations.

Water-gauge readings (automatic) were kept up all the year at Amherstburg, these readings being transmitted to the Lake Survey office.

As a result of the above work there is at present a channel, in daily use, of at least 19 feet depth and at least 250 feet width, at a Lake Erie stage of 572.6 feet above mean tide at New York, such stage being the mean stage of thirty years from 1871 to 1901.

By the end of the present working season, under existing contracts, this 19-foot depth will extend over at least 420 feet width. New contracts, now in preparation, are expected to secure 21 feet depth over at least 600 feet width at a 570.8 Lake Erie stage, that of the lowest monthly mean so far known during navigation seasons.

All this work has been done under the local charge of Assistant Engineer C. Y. Dixon, whose careful and detailed report shows the method and cost of work and contains much other interesting information.

For the due progress of the new work provided for by the river and harbor act of June 13, 1902, an appropriation of \$450,000 will be needed in 1904, under the sundry civil act. Reports as to the full cost of the new work will be submitted to Congress at its next session.

#### *Money statement.*

July 1, 1902, balance unexpended .....	\$788, 484. 65
Amount appropriated by sundry civil act approved March 3, 1903 .....	450, 000. 00
	<hr/> 1, 238, 484. 65
June 30, 1903, amount expended during fiscal year, less \$91.90 received from sale of condemned Government property .....	247, 767. 45
July 1, 1903, balance unexpended .....	990, 717. 20
July 1, 1903, outstanding liabilities .....	48, 708. 43
July 1, 1903, balance available .....	<hr/> 942, 008. 77
July 1, 1903, amount covered by uncompleted contracts .....	<hr/> 5, 122. 10
{ Amount (estimated) required for completion of existing project .....	800, 000. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1905, in addition to the balance unexpended July 1, 1903 .....	450, 000. 00
{ Submitted in compliance with requirements of sundry civil act of June 4, 1897.	



20

w  
th  
ra  
se  
m  
g

at  
ar  
su

cc  
in  
ti  
w  
W  
aj

A  
●

un  
st  
n

th  
ti  
at  
n

E  
n  
n

h  
n  
c

J  
A

J

J  
J

J

J

{  
.  
.  
}

## APPROPRIATIONS.

June 23, 1874 .....	\$25,000	June 3, 1896 .....	\$30,000
June 18, 1878 .....	100,000	March 3, 1899 .....	100,000
March 3, 1879 .....	50,000	June 6, 1900 (sundry civil act)	200,000
June 14, 1880 .....	50,000	March 3, 1901 (sundry civil act)	325,000
March 3, 1881 .....	50,000	June 13, 1902 .....	500,000
August 2, 1882 .....	60,000	June 28, 1902 (sundry civil act)	136,500
July 5, 1884 .....	200,000	March 3, 1903 (sundry civil act)	450,000
August 5, 1886 .....	37,500		
August 11, 1888 .....	130,500		
July 13, 1892 .....	30,000		
August 18, 1894 .....	30,000	Total .....	2,504,500

The following repayments of amounts expended are omitted from the appropriation list, to the footing of which they have heretofore been improperly added, and the total (\$110.41) has been deducted from the total expenditures:

Receipts from sales of fuel to officers between October, 1884, and December, 1886 .....	\$108.41
Repayment of disallowance, voucher 4, November, 1885 (see p. 2268, Report Chief of Engineers, 1887) .....	2.00
Total .....	110.41

## ABSTRACT OF CONTRACTS IN FORCE DURING THE FISCAL YEAR ENDING JUNE 30, 1903.

*Contract dated May 18, 1900, for dredging Lime Kiln Crossing.*

Name of contractor: James B. Donnelly, Buffalo, N. Y.

Rates: \$2.27 per cubic yard, bank measurement (full rate), and \$1.13½ per cubic yard, bank measurement (half rate).

Date of approval: June 4, 1900.

Date of beginning work: June 23, 1900.

Date of expiration (as extended): Indefinite.

*Contract dated July 3, 1900, for dredging Ballard's Reef channel.*

Name of contractor: The Buffalo Dredging Company, Buffalo, N. Y.

Rates: \$2.65 per cubic yard, bank measurement (full rate), and \$1.32½ per cubic yard, bank measurement (half rate).

Date of approval: July 30, 1900.

Date of beginning work: August 9, 1900.

Date of expiration (as extended): Indefinite; completed November 18, 1902.

*Contract dated June 6, 1901, for dredging Annersburg reach.*

Name of contractor: M. Sullivan, Detroit, Mich.

Rate: \$2.90 per cubic yard, bank measurement.

Date of approval: June 27, 1901.

Date of beginning work: July 5, 1901.

Date of expiration (as extended): Indefinite.

*Contract dated June 6, 1902, for dredging at south end of Lime Kiln Crossing.*

Name of contractor: Donnelly Contracting Company, Buffalo, N. Y.

Rates: \$4.21 per cubic yard, bank measurement (full rate), and \$2.10½ per cubic yard, bank measurement (half rate).

Date of approval: July 3, 1902.

Date of beginning work: August 15, 1902.

Date of expiration: About July 10, 1903.

*Contract dated June 10, 1902, for time work by dredging plant.*

Name of contractor: G. H. Breyman & Bros., Toledo, Ohio.

Rate: \$17 per hour.

Date of approval: June 17, 1902.

Date of beginning work: About August 15, 1902.

Date of expiration: Indefinite; completed December 31, 1902.

## 2040 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

*Contract dated June 13, 1902, for dredging north end of Amherstburg reach.*

Name of contractor: M. Sullivan, Detroit, Mich.  
 Rates: \$2.90 per cubic yard, bank measurement (full rate), and \$1.45 per cubic yard, bank measurement (half rate).  
 Date of approval: June 30, 1902.  
 Date of beginning work: About August 15, 1902.  
 Date of expiration: July 10, 1903; completed October 21, 1902.

*Contract dated August 28, 1902, for constructing a scow.*

Name of contractor: Charles Boston & Sons, Delray, Mich.  
 Rate: For the lump sum of \$3,692.  
 Date of approval: September 5, 1902.  
 Date of beginning work: October 14, 1902.  
 Date of expiration (as extended): Indefinite; completed January 10, 1903.

*Emergency contract dated June 30, 1903, for hire of tug.*

Name of contractor: M. Sullivan, Detroit, Mich.  
 Rate: \$600 per month.  
 Date of beginning work: July 10, 1903.  
 Date of expiration: About December 10, 1903.

### COMMERCIAL STATISTICS.

No accurate record of the commerce of the Detroit River is obtainable; but from data contained in marine post-office and custom-house records of Detroit River ports (both American and Canadian), it is estimated that not less than 44,000,000 tons of freight were carried through the river during the calendar year 1903, as follows:

#### *Detroit River.*

Net registered tonnage of all vessels passing Detroit, as well as of those stopping at Amherstburg, Windsor, and Detroit .....	39,328,689
Freight carried by such vessels, in tons of 2,000 pounds each .....	44,260,506
Number of vessel passages (approximately) .....	33,000
Date of first passage .....	Apr. 2, 1902
Date of last passage .....	Dec. 22, 1902

(See, also, Reports given under head of "Operation and Care of St. Clair Flats Canal.")

The above statistics, although still somewhat approximate, are considered to be the most complete compilation yet made for this waterway; and the method of its preparation, as given by the report of Assistant Engineer E. S. Wheeler, dated May 4, 1903, is herewith appended for use of other persons engaged in compiling and comparing similar statistics.

### REPORT OF MR. E. S. WHEELER, ASSISTANT ENGINEER.

ENGINEER OFFICE, UNITED STATES ARMY,  
 Detroit, Mich., May 4, 1903.

MAJOR: I have the honor to submit the following report upon the commerce using the Detroit River and also the St. Clair Flats Canal.

For several years the Detroit marine post-office has kept a list of all vessels passing Detroit. The postmaster, Mr. F. B. Dickerson, kindly allowed the list for the season of 1902 to be copied. Concerning the completeness of this list, Mr. Dickerson says, in a letter dated April 7, 1903: "The number of vessel passages reported by the marine post-office in this city is correct, as they keep an account of all passages, whether they have mail for them or not."

After the list was copied the net registered tonnage was copied from the American and Canadian "blue books" and summed. This gave the total net registered tonnage passing Detroit without stopping. The commerce that stopped in Detroit and Windsor was obtained from the American and Canadian customs offices. The business at Amherstburg was obtained from the customs office at that place.

The Detroit customs office includes the villages along the American side of the Detroit River, and the Canadian customs office includes the villages along the Canadian side, except Amherstburg. (The passenger and railroad ferry boats plying between Detroit and Windsor and Detroit and Belle Isle are not included.)

The passages are collected and summed as follows:

	Net tons.
Passing Detroit .....	35, 479, 039
Stopping at Detroit and Windsor.....	3, 667, 212
Stopping at Amherstburg.....	182, 438
Total net registered tons.....	39, 328, 689

The above results are compiled entirely from official lists, which are intended to be, and undoubtedly are, accurate and complete. The derived net registered tonnage is therefore believed to be quite accurate and trustworthy.

A close approximation to the freight tonnage can be obtained by comparison with the tonnage at the St. Marys Falls Canal, at which place the records of both the net registered tonnage and the actual freight tonnage, in tons of 2,000 pounds each, are kept. It is found that the actual freight tonnage exceeds the net registered tonnage by 0.1254 per cent. If it is assumed that the ratio between registered and freight tonnage is the same in Detroit River as at the St. Marys Falls Canal, then the actual freight tonnage which used Detroit River in 1902 would be 44,260,506. This value is probably a close approximation, for more than half the tonnage of the Detroit River comes through St. Marys Falls Canal, and the ratio between registered and freight tonnage for this portion would be correct. Of the remainder, that part going to Lake Michigan, the ratio is likely to be a little too small, because there are not so many boats going light to Lake Michigan as there are going light to Lake Superior. Again, that part which stops at Detroit is largely passenger boats, and the ratio is likely to be too large. These two corrections, being on opposite directions, tend to eliminate each other, and it is not possible to determine whether the aggregate ratio is too large or too small. There is, however, such a similarity between the commerce of the Detroit River and of the St. Marys River that it is probable that the ratio found at St. Marys Falls Canal is very near the correct ratio for Detroit River.

The commerce using St. Clair Flats Canal is very nearly the same as that of the Detroit River. There are, however, some small differences, as follows: It is found from the Detroit and Windsor customs house records that 2,047,006 net registered tons stopping at Detroit and Windsor do not go on up the river, but turn around and go back down. This then should be subtracted from the Detroit River tonnage. The Amherstburg business, amounting to 182,438 net tons, does not pass the St. Clair Flats Canal, and should also be subtracted. Finally, there is a small amount of business done at Lake St. Clair ports which passes St. Clair Flats Canal but does not reach Detroit River. Of this business we have no actual record, but it is estimated by the custodian of the canal that one schooner per week and one passenger boat per day pass the canal and stop at Lake St. Clair ports, aggregating 20,000 tons during the last season. This amount should be added. Making these corrections, the total net registered tons passing St. Clair Flats Canal during last season is found to be 37,119,245 net tons. Multiplying by the ratio 0.1254 per cent gives 41,773,998 freight tons of 2,000 pounds each.

The work of compiling and reducing the preceding statistics has been considerable. More than 33,000 vessel passages were considered. The work was done by Junior Engineers H. McNaughton, H. R. Allen, and Bamlet Kent, and Master C. L. Wilson, Custodian William Mott, and Steam Engineer A. R. Crook.

#### SUMMARY.

##### *Detroit River.*

Net registered tons, 39, 328, 689.  
 Freight, in tons of 2,000 pounds each, 44, 260, 506.  
 Date of first passage, April 2.  
 Date of last passage, December 22.

##### *St. Clair Flats Canal.*

Net registered tons, 37, 119, 245.  
 Freight, in tons of 2,000 pounds each, 41, 773, 998.

Very respectfully, your obedient servant,

E. S. WHEELER,  
*Chief Assistant Engineer.*

Maj. W. H. BIXBY, *Corps of Engineers.*

## 2042 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

REPORT OF MR. CHAS. Y. DIXON, ASSISTANT ENGINEER.

DETROIT, MICH., July 10, 1903.

MAJOR: I have the honor to submit the following report of operations under my charge during the fiscal year ending June 30, 1903, connected with the improvement of the Detroit River:

*Item A, Ballards Reef channel.*—The object of this improvement is the deepening to 21 feet (at a Lake Erie stage of 572.6 feet above mean tide at New York) of the west 300 feet of a 600-foot channel along the Grosse Ile south channel range. The length of channel covered by this improvement was about 8,500 feet, and the least depth prior to improvement was about 18.5 feet. This work was performed by the Buffalo Dredging Company, of Buffalo, N. Y., under formal contract dated July 3, 1900, the contract price being \$2.65 per cubic yard, bank measurement, for all material excavated above 22 feet grade and \$1.325 per cubic yard for all material excavated between the 22 and 23 feet grades.

Work under this contract was commenced on August 9, 1900. The contract time expired on November 30, 1901, but the work being then incomplete, the time limit was waived, the contractors agreeing to continue and complete the work at the contract price, using such plant as may be approved by the engineer officer in charge.

Operations were continued during the fiscal year until November 18, 1902, when the work was completed. The plant in use was as follows: One drill boat equipped with 3 drills (105 hours worked), dipper dredge No. 1 (21 hours worked), dipper dredge No. 9 (518 hours worked), clam-shell dredge No. 4 (546 hours worked), 3 derrick scows with diving outfits (total, 1,810 hours worked), 2 tugs, and the necessary dump scows.

The amount of material removed during the fiscal year was 2,396 cubic yards, full rate (above 22 feet grade), 1,537.1 cubic yards, half rate (between 22 and 23 feet grades), and 3,105.1 cubic yards (below 23 feet grade), for which no payment was made, and the amount earned by the contractors was \$8,386.06. The total amount of material removed under this contract was 26,336 cubic yards (full rate), 47,807.1 cubic yards (half rate), and 61,405.1 cubic yards (no payment), and the amount earned by the contractors was \$133,134.81.

The material removed consisted mainly of limestone bedrock, with some large buried boulders, loose stones, hardpan, clay, and sand. Over about 80 per cent of the area improved it was found more economical to do drilling and blasting before excavating the material. The holes were generally drilled at the corners of 5-foot squares, and during the fiscal year the number of hours worked by the drills was 105, the number of holes drilled was 132, being 400 linear feet. The number of pounds of dynamite used was 300.

An examination of the area improved under this contract by means of bars suspended from the sweeping raft to the 21-foot grade was completed on November 18, 1902, on which date the work was accepted and the contract closed. The survey on which was based the final estimate was made during January, 1903, and the final estimate was submitted on April 2, 1903.

*Section 2, Lime Kiln Crossing.*—The object of this improvement is to secure a channel depth of 21 feet (at a Lake Erie stage of 572.6) throughout the west 180 feet of a 600-foot channel along the Lime Kiln Crossing range. The length of channel covered by this contract is 3,000 feet, and the least depth prior to improvement was about 14 feet. This work is being performed by James B. Donnelly, of Buffalo, N. Y., under formal contract dated May 18, 1900, the contract price being \$2.27 per cubic yard, bank measurement, for material above 21 feet grade, and \$1.135 per cubic yard, bank measurement, for material removed between the 21 and 23 feet grades. Work under this contract was commenced on June 23, 1900, and the contract time expired on November 30, 1901, but the work being then incomplete the time limit was waived, the contractor agreeing to continue and complete the work at the contract price, using such plant as may be approved by the engineer officer in charge.

Operations were continued during the fiscal year until November 26, 1902, were resumed on May 6, 1903, and are still in progress. The plant used during the season of 1902 was one drill boat equipped with three drills (881 hours worked), one dipper dredge (910 hours worked), one clam-shell dredge (335 hours worked), one derrick scow with diving outfit (1,049 hours worked), two tugs, and the necessary dump scows. The plant used during the season of 1903 was one derrick scow with diving outfit (454 hours worked), and one tug.

The amount of material removed during the fiscal year was 10,998 cubic yards, full rate (above 21-foot grade), 4,000 cubic yards, half rate (between 21 and 23 feet grades), and 12,682 cubic yards (below 23 feet grade), for which no payment was made. The amount earned by the contractor was \$29,505.46. The amount of material removed



under this contract to the close of the season of 1901 was 44,130 cubic yards (full rate), 16,128 cubic yards (half rate), and 6,829 cubic yards (no payment), as determined by survey of December, 1901. The total removed since the close of the season of 1901 to June 30, 1903, is now estimated as 25,684 cubic yards (full rate), 9,341 cubic yards (half rate), and 14,907 cubic yards (no payment), subject to revision by computations from survey made during January, 1903.

The material removed consisted mainly of limestone bedrock, which required to be drilled and blasted before being removed. The holes were generally drilled at the corners of 5-foot squares, and during the fiscal year the number of holes drilled was 1,967, being 13,343 linear feet, and the number of pounds of dynamite used was 12,475.

The entire area to be improved under this contract has been dredged, but there are still remaining many loose stones and boulders projecting above the required 21-foot grade—this over about 35 per cent of the entire area. The area improved under this contract was covered by the survey made during January, 1903, which survey indicates that the general depth of water resulting from the dredging is about 23 feet, but there are still several areas of small extent which will have to be redredged before the required depth can be secured. The work required under this contract will probably be completed about September 1, 1903.

*Item A, widening at south end of Lime Kiln Crossing.*—The object of this improvement is the deepening to 21 feet (at a Lake Erie stage of 571.5 feet) of a triangular area 600 feet long and 180 feet wide west of the channel at the south end of the Lime Kiln Crossing Range. The least depth prior to improvement was about 16 feet. This work is being performed by the Donnelly Contracting Company, of Buffalo, N. Y., under formal contract dated June 6, 1902, the contract price being \$4.21 per cubic yard, bank measurement, for material excavated above 22 feet grade, and \$2.105 per cubic yard for all material excavated between the 22 and 23 feet grades.

Work under this contract was commenced on July 7, 1902, and the contract time expires on July 17, 1903. The plant in use during the season of 1902 was one drill boat equipped with three drills (1,137 hours worked), one dipper dredge (175 hours worked), one clam-shell dredge (72 hours worked), one derrick scow with diving outfit (81 hours worked), two tugs and the necessary dump scows. Operations during the season of 1902 ceased on November 22, and have not since been resumed.

The amount of material removed during the fiscal year was 3,630 cubic yards, full rate (above 22-foot grade), 1,850 cubic yards, half rate (between 22 and 23 feet grades), and 1,488 cubic yards (below 23-foot grade) for which no payment was made, subject to revision by computations from survey made during January, 1903. The amount earned by the contractors was \$19,176.55.

The material removed consisted mainly of limestone bedrock, which required to be drilled and blasted before being removed. The holes were generally drilled at the corners of 5-foot squares, and the number of holes drilled was 2,638, being 18,103 linear feet, and the number of pounds of dynamite used was 19,450.

The entire area included under this contract has been improved by dredging, but many loose stones and boulders were left projecting above the required 21-foot grade. These loose stones and boulders have been removed from about 50 per cent of the area. This entire area was covered by the survey of January, 1903, which survey indicates that the general depth of water resulting from the dredging is about 23 feet. It is expected that it will require about one month to complete this work with one derrick scow with driving outfit.

*Item A, Amherstburg reach.*—The object of this improvement is the deepening to 21 feet (at a Lake Erie stage of 571.5 feet) of a 500-foot channel throughout the greater part of the length of Amherstburg reach. The length of channel covered by this contract is about 4,500 feet, and the least depth prior to improvement was about 16.5 feet. This work is being performed by M. Sullivan, of Detroit, Mich., under formal contract dated June 6, 1901, the contract price being \$2.90 per cubic yard, bank measurement, for all material excavated above 22-foot grade.

Work under this contract was commenced on June 4, 1901, and continued during the fiscal year to December 13, 1902, and resumed on March 20, 1903. The work is still in progress. The contract time expired on December 1, 1902, and it has been extended to August 30, 1903.

The plant used during the fiscal year was as follows: Dipper dredge *Old Glory* (1,862 hours worked), dipper dredge *Brian Boru* (1,598 hours worked), dipper dredge *Gladiator* (1,070 hours worked), drill boat *Dynamiter* (3 drills, 4,702 hours worked), drill boat *No. 3* (3 drills, 2,830 hours worked), two derrick scows with driving outfits (*No. 1*, 730 hours worked, and *No. 2*, 1,283 hours worked), three tugs, and the necessary dump scows.

The amount of material removed during the fiscal year was 37,798 cubic yards, full rate (above 22-foot grade), and 55,898 cubic yards (below 22-foot grade) for which

no payment was made. The amount earned by the contractor was \$109,614.20. The total dredged to the close of the season of 1902, under this contract, was 81,746 cubic yards (full rate), and 72,009 cubic yards (no payment), as determined by survey of January, 1903. The total dredged since the close of the season of 1902 to June 30, 1903, is now estimated as 19,703 cubic yards (full rate), and 17,472 cubic yards (no payment), subject to revision by final survey.

The material removed consisted of limestone bedrock, bowlders, clay, and sand. Over about 75 per cent of the area improved it was found necessary to do drilling and blasting before excavating the material. The holes were drilled at the corners of 5-foot squares, the number of holes drilled was 19,462, being 105,356 linear feet, and the number of pounds of dynamite used was 154,872.

The entire west half (250 feet width) of the channel has been improved by dredging, and the loose stones and bowlders left after dredging operations were removed from about 90 per cent of this area. This part of the channel now has a least depth of 19.5 feet and it is used by passing vessels. About 90 per cent of the east half (250 feet width) of the channel has been improved by dredging and generally a depth of about 23 feet has been secured. There are yet remaining, however, several areas of small extent requiring to be redrilled and redredged. About 75 per cent of the east half of the channel has been cleared to the required depth by the removal of loose stones and bowlders. It is now expected that the work required under this contract will be completed about August 30, 1903.

*Item B, north end of Amherstburg reach.*—The object of this improvement is the deepening to 21 feet (at a Lake Erie stage of 571.5 feet) of the west half of a 500-foot channel near the north end of Amherstburg reach. The length of channel covered by this contract was 1,000 feet, and the least depth prior to improvement was about 19 feet. This work was performed by M. Sullivan, of Detroit, Mich., under formal contract dated June 13, 1902, the contract price being \$2.90 per cubic yard, bank measurement, for material excavated above the 22-foot grade, and \$1.45 per cubic yard for all material excavated between the 22 and 23 feet grades.

Work under this contract was commenced on June 24, 1902, and continued until October 21, 1902, when it was completed. The plant used consisted of one dipper dredge (369 hours worked), one derrick scow with diving outfit (360 hours worked), one tug, and the necessary dump scows.

The material removed consisted of bowlders, hardpan, clay, and sand. During the fiscal year there was removed 3,256.7 cubic yards, full rate (above 22-foot grade), 3,569.8 cubic yards half rate (between 22 and 23 feet grades), and 6,653.1 cubic yards (below 23-foot grade) for which no payment was made. The amount earned by the contractor during the fiscal year was \$14,620.64. The total amount of material removed under this contract was 4,004.7 cubic yards (full rate), 3,569.8 cubic yards (half rate), and 6,653.1 cubic yards (no payment), as determined by the final survey; and the amount earned by the contractor was \$16,789.84.

An examination of the area improved under this contract by means of bars suspended from the sweeping raft to the 21-foot grade was completed on October 21, 1902, on which date the work was accepted and the contract closed. The survey on which was based the final estimate was made during October, 1902, and the final estimate was submitted on October 27, 1902.

*Item C, time work by dredging plant.*—The object of this improvement was the deepening to 21 feet (at a Lake Erie stage of 571.5) of a part of the channel at the north end and also at the south end of Amherstburg reach. This work was performed by G. H. Breyman & Bro., of Toledo, Ohio, under formal contract dated June 10, 1902, for furnishing and operating a dredging plant on the basis of time work, the contract price being \$17 per hour. Work under this contract was commenced on June 24, 1902, and completed on October 2, 1902. The plant used consisted of one dredge (No. 3), one tug, and two dump scows.

During the fiscal year there was removed clay, bowlders, sand, gravel, and some limestone bedrock from an area of about 34,900 square yards to the extent of 67,250 cubic yards, scow measurement. The time worked for which payment was made was nine hundred and nine and fifteen-sixtieths hours, and the amount earned by the contractor was \$15,457.25.

The total amount of material removed under this contract was 74,655 cubic yards, scow measurement, and the total amount earned by the contractors was \$16,643. The least depth prior to this improvement was about 15 feet, and the resulting depth is generally 22 feet, with a clear depth of about 20 feet. This work was performed at a cost to the United States of about 23 cents per cubic yard, not including the cost of inspection.

*Plant operated by hired labor.*—During the fiscal year the plant operated by hired labor was employed as follows:

During July and August, 1902, an examination was made by means of the sweeping raft to determine the depth of water over the dumping grounds where material was deposited under existing contracts for excavation. High points of rock over these dumping grounds were removed, and a clear depth of 5 feet (at a Lake Erie stage of 572.6) was secured.

During September, October, and November, 1902, examinations were made by means of the sweeping raft of areas improved under contracts for excavation at Item A, Ballards reef channel; Section 2, Lime Kiln Crossing; Items A and B, Amherstburg reach; dredging plant furnished and operated on the basis of time work at the north end of Amherstburg reach and along Hackett Range.

During March and April, 1903, an examination by means of the sweeping raft was made of the channel from the north end of Lime Kiln Crossing to the south end of Bois Blanc Island. This was done for the purpose of locating and removing obstructions to navigation. Several small bowlders were found and removed, leaving a clear depth of 19 feet (at a Lake Erie stage of 572.6).

During May and June, 1903, the derrick scow with diving outfit, belonging to the United States, was operated by hired labor along the Grosse Isle South Channel Range, the object being to do work contributing to the securing of a channel depth of 21 feet (at a Lake Erie stage of 570.8) for a width of 600 feet. There were removed 370 cubic yards of bowlders from an area of about 42,000 square yards, at a cost of \$2,128, or \$5.75 per cubic yard.

*Present condition of channel.*—As a result of these several improvements the present condition of the channel is as follows: At a Lake Erie stage of 572.6 feet above mean tide at New York there is a clear depth of 21 feet for a width of 600 feet or more (300 feet or more each side of the sailing line) from Detroit to the north end of Lime Kiln Crossing. Along the Lime Kiln Crossing Range there is a clear depth of 19 feet for a width of 420 feet, with contracts in force providing for a clear depth of 21 feet for an additional 180 feet to the westward, and for a clear depth of 22.1 feet at the widening to the westward of the south end of this range, but no part of this additional width is as yet available to navigation. Along the Bois Blanc Island Range there is a clear depth of 19.5 feet for a width of 600 feet. Along Amherstburg reach, for a length of 2,500 feet at the north end, within the west 250 feet there is a clear depth of 22.1 feet (this is now available to navigation), and within the east part (about 200 feet width) there is a clear depth of 19 feet, and for the remaining part of the length of this range (about 4,500 feet) there is a clear depth of 20.6 feet within the west 250 feet, with a contract in force providing for a clear depth of 22.1 feet for the full 500 feet width. From the south end of Amherstburg reach to one-half mile south of Bois Blanc Island there is a clear depth of 19 feet for a width of 500 feet. From one-half mile south of Bois Blanc Island to Bar Point there is a clear depth of 21 feet for 600 feet width, and from Bar Point to Detroit River light-house there is a clear depth of 20 feet for 800 feet width.

*Construction of scow.*—During the fiscal year a scow was constructed for use as a derrick scow on the improvement of the Detroit River. This work was done by Charles Boston & Sons, of Delray, Mich., under formal contract dated August 28, 1902. The construction of the scow was commenced on October 8, 1902, and the contract time expired on December 12, 1902, but the work being then incomplete the contract time was extended to January 10, 1903, on which date the work was completed. The cost of this work was \$3,598.67, being the contract price (\$3,692) for the delivery of the scow complete less the cost of inspection (\$93.33) during the period of extension.

*Surveys.*—During October, November, and December, 1902, surveys were made covering the areas improved under contracts for excavations at Item A, Ballards Reef channel, Section 2, Lime Kiln Crossing, and Item B, north end of Amherstburg reach. These surveys consisted in taking soundings at the corners of 10-foot squares, the soundings being taken from the sweeping raft when anchored in the desired positions. These surveys were made in order that the contractor's estimates might be computed. The number of soundings taken was 16,935, at a cost of \$1,150, or 6 $\frac{1}{2}$  cents per sounding.

During January and February, 1903, ice surveys were made covering areas improved under existing contracts for excavation at Item A, Ballards Reef channel; Section 2, Lime Kiln Crossing; Item A, Amherstburg reach; also covering areas to be improved under new contracts for excavation at Ballards Reef and at Hackett Range. These surveys consisted in taking soundings through the ice at the corners of 10-foot squares. The number of soundings taken was 222,680, at a cost of \$3,550, or 1.6 cents per sounding.

During May and June, 1903, a survey was made for the better development of the channel leading to Wyandotte, Mich. This survey consisted in the taking of time

## 2046 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

soundings between buoys, the positions of which buoys were determined by transit pointings. The number of soundings taken was 11,900, at a cost of \$428, or 3.6 cents per sounding.

*Water-gauge readings.*—The automatic water gauge at the mouth of the Detroit River was attended to regularly during the year, and the record derived therefrom was reduced. The following are the elevations above mean tide at New York of the mean stage for the several months:

	Feet.		Feet.
July, 1902 .....	572.76	January, 1903 .....	571.59
August, 1902 .....	572.77	February, 1903 .....	571.58
September, 1902 .....	572.41	March, 1903 .....	572.21
October, 1902 .....	572.27	April, 1903 .....	573.06
November, 1902 .....	571.97	May, 1903 .....	573.13
December, 1902 .....	571.75	June, 1903 .....	573.01

The highest stage of water during the year was 574.41 feet on May 29, 1903, and the lowest stage was 568.48 feet on February 4, 1903. The greatest fluctuations during a period of 24 hours were as follows: 3.86 feet on November 29, 1902; 4.43 feet on February 4, 1903, and 4.13 feet on February 8, 1903.

Very respectfully, your obedient servant,

CHAS. Y. DIXON, *Assistant Engineer.*

Maj. W. H. BIXBY, *Corps of Engineers.*

### Q Q 8.

#### REMOVING SUNKEN VESSELS OR CRAFT OBSTRUCTING OR ENDANGERING NAVIGATION.

*Wreck of barge Richard Winslow.*—This barge, loaded with iron ore, was sunk in the Straits of Mackinac September 5, 1898. Although marked by a gas buoy, the wreck was considered a dangerous obstruction to navigation, and was so reported March 1, 1902; an allotment of \$3,000 was thereupon made on March 6, 1902, for its removal, followed by an additional allotment of \$1,000 on November 29, 1902.

Weather conditions and the necessity for the use of the steamer *Hancock* on other important work combined to prevent active work of removal of this wreck until 1902. Then contract work from November 11 to December 5, 1902, using divers and explosives, gave results reported to leave a clear depth of 24.5 feet at low water over the wreck. Examinations made in June, 1903, by Asst. Engineer E. S. Wheeler showed depths of at least 24 feet everywhere, this being considered sufficient for the needs of present navigation. The total cost of the work was \$3,610.84. The balance of funds (\$389.16) will be returned to the Treasury.

*Wreck of schooner George H. Wand.*—This vessel was sunk by collision on April 17, 1902, in St. Clair River, near the mouth of Black River. The wreck was reported as a serious menace to navigation on May 14, 1902, and an allotment of \$1,000 for its removal was made on May 22, 1902. Its removal, in progress at the beginning of the fiscal year, was completed on July 2, 1902, at a total cost of \$697.28; after which the balance of funds for such work (\$302.72) was returned to the Treasury.

*Wreck of schooner Gleniffer.*—This schooner, sunk June 2, 1902, near the Star Island dock, in the main channel of the lower St. Clair River, was removed by the U. S. S. *Hancock* and party, using explosives, between July 7 and July 10, 1902, until a clear depth of at least 24 feet was secured over the site of the wreck. The total cost of the work was \$399.94. The balance of the allotment (\$0.06) was returned to the Treasury.

## REPORT OF MR. E. S. WHEELER, ASSISTANT ENGINEER.

ENGINEER OFFICE, UNITED STATES ARMY,  
Detroit, Mich., July 8, 1903.

MAJOR: I have the honor to submit the following report of operations under my charge during the fiscal year ending June 30, 1903, connected with the examination and removal of wrecks:

## WRECK OF SCHOONER RICHARD WINSLOW.

The schooner *Richard Winslow* was sunk in 1898 near White Shoals, north end of Lake Michigan. She was loaded with 1,600 tons of iron ore, and lay in 29 feet of water.

The light-house department placed a gas buoy near the wreck, and kept it there until near the close of the season of 1902.

I was directed by Major Bixby to make an examination of the wreck. I left Detroit on the steamer *Hancock* July 15, 1902, made the necessary examinations, and returned to Detroit on the 28th of July. Sweeping bars were used, and the least depth found over the wreck was 18 feet. The wreck could be seen quite distinctly. It was much broken up by the ice. A depth of 18 feet in the open lake was a danger to commerce.

Accordingly the wrecking firm of James Reid & Sons were employed to increase the depth over the wreck by blasting. This firm sent the tug *B. W. Aldrich* with the necessary diving outfit and explosives to the wreck, leaving Port Huron November 11, and completing the work December 5. An aggregate of 200 pounds of dynamite was exploded on the wreck. An examination with sounding line showed a least depth of 24½ feet.

I was directed by Major Bixby to make a second examination of the wreck. I left Detroit with steamer *Hancock* June 1, and returned June 12, 1903. The wreck was examined with sweeping bars, and the least depth found was between 24 and 25 feet. Since the depth is greater than that to which improvements are carried, this wreck is no longer a danger to commerce.

## WRECK OF SCHOONER GEO. H. WAND.

The schooner *Geo. H. Wand* sunk on the shoal opposite mouth of Black River, Port Huron, Mich. She sank in 14 feet of water. The strong current formed a shoal below the wreck on which the depth of water was less than nine feet. The wreck was blown up in June, 1902. The shoal remained until November, 1902, when, during the progress of the work of improving the shoal near the mouth of Black River, it was removed by dredging. Several large pieces of wreck were found and removed by the dredge. A depth of 14 feet when Lake Huron is at stage 580 feet was obtained. This depth is equal to the depth over other parts of the shoal in the vicinity.

## WRECK OF SCHOONER GLENIFFER.

The schooner *Gleniffer* was sunk June 2, 1902, near the Star Island dock, St. Clair Flats, in about 40 feet of water. Since this wreck lay in the channel and had a minimum depth of 16 feet of water, it was a serious obstruction to navigation.

I was directed by Major Bixby to remove the wreck to a depth of at least 24 feet. A diver with diving outfit was taken on board the steamer *Hancock* and blasting began on July 7 and continued until July 10, when an examination with sweeping bars showed a clear depth of 24 feet. The removal of this wreck was not difficult. Lying as it was in more than 40 feet of water, it was only necessary to blast off the upper works to the required depth and let them float away.

## MISCELLANEOUS.

The wreck of the schooner *Martin*, lying in St. Clair River near Port Huron, was swept over and a clear depth of 21 feet of water found.

The schooner *Chas. Luling* lost her large anchor in the St. Clair Flats Canal, causing serious danger to passing boats. This anchor was picked up and placed on the bank of the canal by the steamer *Hancock* December 19, 1902.

A float light, sunk in 40 feet of water near Marine City, was grappled, raised, and replaced by steamer *Hancock* November 12, 1902.

Very respectfully,

E. S. WHEELER,  
Assistant Engineer.

Maj. W. H. BIXBY,  
Corps of Engineers.



## APPENDIX R R.

---

### IMPROVEMENT OF CERTAIN RIVERS AND HARBORS ON LAKE ERIE, IN THE STATE OF OHIO.

---

*REPORT OF MAJ. DAN C. KINGMAN, CORPS OF ENGINEERS, OFFICER  
IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1903, WITH  
OTHER DOCUMENTS RELATING TO THE WORKS.*

#### IMPROVEMENTS.

- |                                       |                                      |
|---------------------------------------|--------------------------------------|
| 1. Toledo Harbor, Ohio.               | 8. Fairport Harbor, Ohio.            |
| 2. Port Clinton Harbor, Ohio.         | 9. Ashtabula Harbor, Ohio.           |
| 3. Sandusky Harbor, Ohio.             | 10. Conneaut Harbor, Ohio.           |
| 4. Huron Harbor, Ohio.                | 11. Removing sunken vessels or craft |
| 5. Vermilion Harbor, Ohio.            | obstructing or endangering navi-     |
| 6. Black River (Lorain) Harbor, Ohio. | gation.                              |
| 7. Cleveland Harbor, Ohio.            |                                      |

#### HARBOR LINES.

12. Maumee River, Toledo Harbor, Ohio.
- 

UNITED STATES ENGINEER OFFICE,  
*Cleveland, Ohio, July 20, 1903.*

GENERAL: I have the honor to forward herewith annual reports for  
work in my charge for fiscal year ending June 30, 1903.

Very respectfully, your obedient servant,

DAN C. KINGMAN,  
*Major, Corps of Engineers.*

Brig. Gen. G. L. GILLESPIE,  
*Chief of Engineers, U. S. A.*

---

## R R 1.

### IMPROVEMENT OF TOLEDO HARBOR, OHIO.

For an account of early history and projects of improvements, see  
pages 2614 to 2616, Report of Chief of Engineers, 1898, and for latest  
projects see pages 3020 and 3021, Report of Chief of Engineers, 1899.

For a statement and estimate of cost of the project of 1899, and

maps showing the limits of "divisions" into which the work is separated, see Report of Chief of Engineers, 1898, pages 2693 to 2705. An accurate map of the harbor of Toledo was published in the Report of Chief of Engineers, 1901.

The dredging plant belonging to the United States was employed at this harbor during the fiscal year, except for about a month, from the middle of May to the middle of June, when it was used elsewhere. It was employed in the river improvement, and excavated during the season 182,270 cubic yards, which makes with the work previously done a total of 713,785 cubic yards of dredging accomplished by this machine. The contractor employed three dredges upon the work during the entire working season of the fiscal year and excavated a total of 983,893 cubic yards. The total of work done on the project in the river and bay amounts to nearly 5,000,000 cubic yards.

The United States dredging plant has been maintained in a serviceable condition. The tug belonging to the plant has a wooden hull which is very old and scarcely serviceable. Authority was obtained for the purchase of a new hull. Proposals were invited for furnishing one but the prices bid proved excessive and the work is now being done by hired labor. The hull is nearly completed.

An examination of the channel shows a continued tendency to shoal although the deposit is not uniformly distributed throughout the entire length of the cut. In some places a slight scour is indicated. The average fill appears to be about one-third of a foot per annum. This would amount in the finished channel to nearly 400,000 cubic yards in a year. The Maumee River discharges not less than 1,000,000 cubic yards of silt per annum and this, no doubt, furnishes the greater portion of the deposit.

For a detailed account of the work done and for use made of the plant belonging to the harbor of Toledo during the past year, attention is respectfully invited to the report of Asst. Engineer William T. Blunt, which is transmitted herewith.

\* \* \* \* \*

#### *Money statement.*

July 1, 1902, balance unexpended .....	\$243, 723. 96
Amount appropriated by sundry civil act approved March 3, 1903 .....	190, 000. 00
November 29, 1902, proceeds of sale of Government property .....	129. 75
	<u>433, 853. 71</u>
June 30, 1903, amount expended during fiscal year .....	113, 454. 15
	<u>320, 399. 56</u>
July 1, 1903, balance unexpended .....	320, 399. 56
July 1, 1903, outstanding liabilities .....	11, 255. 20
	<u>309, 144. 36</u>
July 1, 1903, balance available .....	<u>594, 575. 97</u>
July 1, 1903, amount covered by uncompleted contracts .....	<u>594, 575. 97</u>
Amount (estimated) required for completion of existing project .....	246, 000. 00
Amount that can be profitably expended in fiscal year ending June 30, 1905, in addition to the balance unexpended July 1, 1903:	
For works of improvement .....	\$246, 000. 00
For maintenance of improvement .....	30, 000. 00
	<u>276, 000. 00</u>
Submitted in compliance with requirements of sundry civil act of June 4, 1897, and of section 7 of the river and harbor act of 1899.	



## AMOUNT AND DATE OF ALL APPROPRIATIONS.

*Old channel.*

June 23, 1866 .....	\$20,000.00	March 3, 1879 .....	\$20,000.00
March 2, 1867 .....	20,000.00	June 14, 1880 .....	30,000.00
April 10, 1869 .....	29,700.00	March 3, 1881 .....	40,000.00
July 11, 1870 .....	50,000.00	August 2, 1882 .....	50,000.00
March 3, 1871 .....	50,000.00	July 5, 1884 .....	20,000.00
June 10, 1872 .....	15,000.00	August 5, 1886 (see note) ..	9,632.61
March 3, 1873 .....	100,000.00	August 11, 1888 .....	5,000.00
June 23, 1874 .....	75,000.00	September 19, 1890 .....	5,000.00
March 3, 1875 .....	75,000.00		
August 14, 1876 .....	60,000.00	Total for old channel.	724,332.61
June 18, 1878 .....	50,000.00		

*Straight channel.*

July 5, 1884 .....	\$25,000.00	June 13, 1902 .....	\$15,000.00
Deduct amount appropri- ated for old channel (see note) .....	9,632.61	June 28, 1902 .....	223,000.00
		November 29, 1902 (pro- ceeds of sale of Govern- ment property) .....	129.75
		March 3, 1903 .....	190,000.00
August 5, 1886 .....	15,367.39		
August 11, 1888 .....	112,500.00	Total for straight channel .....	1,616,497.14
September 19, 1890 .....	150,000.00		
July 13, 1892 .....	200,000.00	Total of all appropriations for Toledo Harbor, Ohio.	2,340,829.75
August 18, 1894 .....	70,000.00	Expended to June 30, 1903.	2,020,430.19
June 3, 1896 .....	150,000.00		
March 3, 1899 .....	150,000.00	Unexpended July 1, 1903.	320,399.56
June 6, 1900 .....	132,500.00		
March 3, 1901 .....	8,000.00		

NOTE.—By act of August 5, 1886, the balance then available of the \$25,000 appropriated July 5, 1884, for straight channel was made available for clearing the old channel.

## LIST OF CONTRACTS IN FORCE DURING THE FISCAL YEAR ENDING JUNE 30, 1903.

*Contract for dredging in straight channel through Maumee River and Bay, and for constructing a dike between turn-out channels, Toledo Harbor, Ohio.*

Name of contractor: The Lydon & Drews Company, Chicago, Ill.

Date of contract: July 21, 1899.

Date of approval: September 23, 1899.

Date of commencement: May 1, 1900.

Date of completion: Continuous contract.

## COMMERCIAL STATISTICS.

The following statistics for the year 1902 relative to the commerce of the harbor of Toledo, Ohio, were compiled from information furnished by the collector of customs and by the owners of vessels that visited the port:

Receipts.	Tons.	Shipments.	Tons.
Coal and coke .....	7,068	Coal and coke .....	2,088,510
Fish .....	1,025	Flour .....	23,392
Grain and produce .....	27,744	Grain and produce .....	187,864
Iron ore .....	1,021,761	Lumber, logs, etc. ....	16,980
Iron, pig .....	2,806	Merchandise .....	75,507
Lumber, logs, etc. ....	149,404	Stone .....	3,915
Merchandise .....	37,191	Miscellaneous .....	3,667
Salt .....	14,992		
Sand and gravel .....	229,174		
Shingles .....	1,448		
Miscellaneous .....	24,334		
Total .....	1,516,947	Total .....	2,349,825

## 2052 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

### Total freight tonnage:

1902..... 3, 866, 772  
1901..... 3, 086, 364

Increase ..... 780, 408

Vessels.	Number.	Tonnage.
Entering .....	2, 418	1, 613, 100
Departing .....	2, 452	1, 622, 661
Built .....	5	7, 568

### Total registered tonnage (vessels entering and departing):

1902..... 3, 235, 761  
1901..... 2, 719, 912

Increase ..... 515, 849

Draft of largest vessels using harbor, 20 feet.

Largest vessels do not load to full depth.

No new vessel lines established during the year.

### REPORT OF MR. WM. T. BLUNT, ASSISTANT ENGINEER.

TOLEDO, OHIO, *July 1, 1903.*

SIR: I have the honor to submit the following report upon Toledo Harbor, Ohio, for fiscal year ending June 30, 1903:

All depths mentioned are given at mean level of Lake Erie, 1860 to 1875, the lake surface being now about three or four tenths feet above that level.

#### STRAIGHT CHANNEL THROUGH MAUMEE RIVER AND BAY.

*Description.*—The work of improving the straight channel through Maumee River and Bay to a depth of 21 feet and width of 400 feet, authorized by river and harbor act of March 3, 1899, has been in progress during working months of the year, both by the U. S. dredge *Maumee* and under contract with the Lydon & Drews Company. At the close of the fiscal year the channel through the bay has been widened 100 feet on its easterly side for 2 miles outward from the river mouth, and work is in progress widening on its westerly side over the same reach. The channel in the river from bay to Wheeling and Lake Erie Railway bridge has also been straightened and widened to 400 feet with upward of 21 feet depth. The work of deepening the 400 feet cut above the Cherry Street Bridge is completed excepting about one cut of 2,000 feet length. Thus the general condition of channel is about as follows:

Outer division, 4 miles, from lake to cribs, original 18 feet cut is 300 feet wide, 21 feet cut is 200 feet wide; middle division, 2 miles inward from cribs, 21 feet cut is 200 feet wide; inner division, 2 miles inward to mouth of river, 21 feet cut is 300 feet wide, and work of widening to 400 feet is in progress; river division, mouth to Wheeling and Lake Erie Railway bridge, 21 feet cut is 400 feet wide with but one angle, off Ironville wharf; division G, Wheeling and Lake Erie bridge to Craig shipyard, natural channel is upward of 20 feet deep for 200 feet width; divisions F and E to Pennsylvania bridge, 21 feet cut is 400 feet wide; division D, to Cherry Street Bridge, natural depth is upward of 21 feet deep for 300 to 400 feet width; division C, to Lake Shore and Michigan Southern bridge, 21 feet cut 4,000 feet long is 360 feet wide and natural channel upward of 21 feet deep 3,000 feet long is 400 feet wide; division B, to Fassett Street Bridge, natural channel upward of 21 feet deep is 400 feet wide; division A, 21 feet cut is 100 feet wide up to Schenck coal wharf.

*U. S. dredge Maumee.*—This dredge has continued work in division C, and has nearly completed the 21 feet cut 400 feet wide and about 4,000 feet long extending from Cherry Street Bridge up to Wabash freight house. Work was suspended November 26, 1902, on account of inclement weather and weak condition of tug, making it unsafe to tow material to the lake. Operations were resumed April 20, 1903. In October, 1902, the dredge cleared up the 21 feet cut through the Wheeling and Lake Erie draw, which, on account of its quick action in moving, it could do with less delay to the bridge and dredge than would occur under contract work.

From May 13 to June 14, 1903, the dredge was engaged at Huron Harbor removing 368 feet of old pier, making bottom for new cribs, and assisting in setting them.

During the fall of 1902 the private works of filling took nearly all the material

dredged, but in the spring of 1903 it was necessary to again tow to the lake. The dipper was thus idle several hours each day, and 50 per cent more material might have been dredged were scows at hand for receiving it. The natural result was less yards per hour worked and of course less wear and tear on machinery.

Following is a tabular summary of work thus far accomplished by this dredge upon the 21 feet project in Toledo Harbor, Ohio:

## STRAIGHT CHANNEL THROUGH MAUMEE RIVER AND BAY.

	Previously reported.	Fiscal year ending June 30, 1903.	Total to date.
	<i>Cu. yds.</i>	<i>Cu. yds.</i>	<i>Cu. yds.</i>
Division A.....	147,722	147,722	147,722
Division C.....	108,169	179,560	287,719
Division E.....	113,615	113,615	113,615
Division F.....	162,007	162,007	162,007
Division G.....		2,720	2,720
Total .....	581,513	182,270	713,783

Cubic yards per hour worked, July to November, 1902, 193; cubic yards per hour worked, April to June, 1903, 167.

*Contract, the Lydon & Drews Company.*—The three dredges which have been on the work from the beginning remain upon it now and are doing very satisfactory work considering the long tow to dump grounds and the restrictions which labor organizations have compelled them to accept. As heretofore, the work has been under the immediate inspection of Mr. William F. Hahn, whose services have been very satisfactory. At the beginning of the year all dredges were at work in the river division. At various times early in July the dredges were transferred to the inner division, straight channel, as the work of each in river division was completed. All were occupied balance of the season in widening the channel 100 feet on its easterly side. At the close of the season's work, November 29, this widening had been completed excepting a small portion at outer end. Work was resumed by two dredges April 24, and by the third April 29, under the special permission required for that month. During the balance of the fiscal year the small portion on easterly side was completed and good progress was made in the widening of inner division on the westerly side. It is hoped that at the end of this season this division will have the 400 feet width for full length.

At 2 a. m., June 17, a large scow loaded with 300 yards of material sank alongside of dredge No. 8 through the carelessness of a watchman. Two dredges and tugs were occupied four days in raising and disposing of this scow. Fortunately the location was such as not to in any way interfere with the passage through the channel.

Following is a tabular summary of work under this contract:

*Straight channel through Maumee River and Bay.*

[Contract, the Lydon & Drews Company, dated July 21, 1899.]

	Previously reported.	Fiscal year ending June 30, 1903.	Total to date.
	<i>Cu. yds.</i>	<i>Cu. yds.</i>	<i>Cu. yds.</i>
River division.....	306,661	64,176	360,837
Inner division.....	581,300	922,253	1,503,553
Middle division.....	564,406	7,464	571,870
Outer division.....	806,467		806,467
Total .....	2,257,824	983,893	3,241,717

*Capacity of dredges.*

	Cubic yards per hour.	
	July to November, 1902.	April to June, 1903.
Lydon & Drews Co., dredge No. 1.....	227	216
Lydon & Drews Co., dredge No. 8.....	218	206
C. H. Starke Co., dredge No. 5.....	185	188

*Comparative soundings.*—Soundings were taken on division H after completion of dredging, and show a very even bottom at about 22 to 23 feet depth. In September, 1902, the entire outer division was sounded, and comparison with the last previous data of October and November, 1901, shows a deposit very evenly distributed over the width of channel, but varying in its length from 0.69 in one section of 800 feet to a scour of 0.25 in another. The heaviest fill is near the inner end, while at the outer end the fill decreases and merges into a scour at the extreme outer end. Excepting this outer end, the lightest fill is through the bar itself, where there is but 6 to 7 feet depth of water on the bank. The average over the entire division is 0.29 fill, indicating an average annual rate of 0.34 feet. No other complete soundings have been taken, but a hurried examination on sections about 1,200 to 1,600 feet apart, at the end of the fiscal year, shows exceedingly few places where depths are less than 21 feet within the limit dredged for that depth, and outside the cribs the depths usually exceed 23 feet.

#### STEAMER VISITOR AND SURVEY PARTY.

The *Visitor* continued in active service until December 8, but steam was kept up until the 15th in anticipation of a possible call to locate wrecks. Active service was resumed April 6. The vessel was on the marine railway, August 5 to 12, for annual overhauling, scraping of bottom, and repainting. Other than this the service was practically uninterrupted. Its work was somewhat hampered by the severe illness of the assistant engineer in October, 1902, and the nearly fatal illness of Captain Stevenson in May and June, 1903. In addition to the regular routine duties of inspection at Toledo, Port Clinton, Sandusky, and Huron harbors, the following special work may be noted:

*Maumee Bay triangulation.*—Many of the shore marks of the triangulation of 1889 having been destroyed and several new light-houses having been built, it became necessary to make an entirely new triangulation of Maumee Bay. This was done in November and December, 1902, after preparatory work in October. Connections were made between the old base line at Ironville and the line, Lone Tree Turtle Island light-house. (See Annual Report, 1890.) Stations 8 to 10 feet high were constructed for shore points and eccentric stations were used on the light-houses. Special report upon this work will be made upon completion of the reductions.

*Wreck steamer Geo. Dunbar.*—This vessel was sunk June 29, 1902, about 6 miles east of Middle Island. Its location was determined and its removal accomplished under contract with Capt. E. J. Dodge, of Put in Bay, Ohio.

*Wreck schooner A. Mosher.*—This vessel ran on Starve Island reef November 30 and became a total wreck, sliding off into deep water and going to pieces. Its location was determined, but owing to the lateness of the season no steps could be taken toward its removal until spring, when the elements had so disposed of it that there remained no known danger to navigation.

The steamer *D. F. Rose* at the same time was run ashore to prevent sinking, but was afterwards saved.

*Wreck steamer C. B. Lockwood.*—This wreck was located and buoyed by Captain Stevenson, of the *Visitor*, under immediate orders of the engineer officer, it lying about northeast by north 36 miles from Cleveland.

*Harbor line, Toledo.*—The harbor line above Lake Shore and Michigan Southern Railway bridge previously laid out on maps was run out on the ground, computed, and referred to shore points for final description.

*Comparison of gauges, Toledo.*—A discrepancy having been found between the gauges in bay and river, a careful comparison was made for three days and a final reduction of all gauges and bench marks was made, so that all are now on the same basis.

*Sandusky River inspection.*—A trip was made to Fremont, Ohio, for inspection of Sandusky River by the officer in charge. Trouble was experienced in passing the bar, and on the outward trip a portion of wire fence was picked up by the propeller. Upon hoisting the stern out of water about 12 pounds of wire was removed from the shaft.

*Soundings.*—At Toledo complete soundings were taken over division H to show results of dredging over the outer division for comparison and over part of the middle division. At Port Clinton complete soundings were taken in harbor and entrance to show results of dredging. At Sandusky soundings were taken over the outer bar in August, 1902, and over the entire length of channels in April and May, 1903, for use in dredging contract.

*Coal consumption and miles run.*—During the season of 1902 *Visitor* ran 6,498 miles, making 1,226 landings and anchorages and burning 290 tons of coal.

## STOREHOUSE AND FLOATING PLANT.

During the winter the fleet, consisting of steamer *Visitor*, dredge *Maumee*, tug *Thos. Spear*, and six dump scows, was laid up in the storage basin as usual, the derrick scow being in use at Huron Harbor, Ohio. General repairs were made by those regular employees who were retained in service.

*Storehouse.*—The house was wired for electric lighting by the dredge dynamo.

*Dredge Maumee.*—It was intended to entirely renew the decks, but the lumber for that purpose was not delivered until it was too late to be of service. It was stored for use next winter. The boom was hoisted out, the swinging circle and heel casting were overhauled and repaired. A great many repairs were made to machinery and boilers, and the entire winter was well spent upon practical work necessary to the proper running of the dredge. On July 1, 1902, the dredge was taken to Detroit for the making and placing of a new hoisting drum, the old one having been found cracked for two-thirds of its circuit, rendering it unsafe. The casting weighed about 3½ tons, and with the entire shaft and gear attached, about 10 tons. An excellent and rapid job was done by the Great Lakes Engineering Works and the dredge returned to Toledo July 12. This was the first serious break in the machinery for about seven years, and while it was not chargeable to fault of anyone it emphasizes the fact that the engineman, George L. Skeldon, is entitled to credit for his careful handling of the dredge.

*Tug Thos. Spear.*—As arrangements had been made for constructing a new hull for this tug no repairs of any kind were made.

*Scows.*—No extensive work was done upon scows, but parts of decks were renewed and some calking done where necessary. Three of these scows are in bad condition and will have to be rebuilt next winter.

*Steamer Visitor.*—This vessel was taken out on marine railway for annual overhauling from August 5 to 12. The bottom was cleaned, sandpapered, and repainted, rudder was enlarged and stern bearing rebabbitted. During the winter the intermediate shaft was taken out and trued up, necessitating its being cut into two pieces and joined again by clamps.

Very respectfully,

Maj. DAN C. KINGMAN,  
Corps of Engineers.

WM. T. BLUNT,  
United States Assistant Engineer.

---

R R 2.

## IMPROVEMENT OF PORT CLINTON HARBOR, OHIO.

The location and early history of this work are given upon pages 2647 and 2648, Report of Chief of Engineers, 1898.

The funds available at the beginning of the fiscal year 1903 amounted to \$5,653.53, and this has been applied to the improvement of the channel by dredging. The depth of water in the lake beyond the end of the jetties was not as great as that in the sheltered channel, consequently the full advantage of the improvement could not be taken by vessels coming to the port.

A contract was entered into for deepening the channel beyond the jetties. The Detroit Dredging Company, of Detroit, Mich., was the successful bidder. Work was continued during the fall of 1902 and completed early in the spring of 1903. It resulted in the removal of 33,764 cubic yards of material and afforded a channel 150 feet wide and 12½ feet deep from the outer end of the jetties to a corresponding depth in the lake. This will prevent loaded vessels from striking the bar when attempting to enter the harbor when the lake is rough.

The jetties at this harbor have been partially protected by a covering of riprap of heavy stone. The work has not yet been completed and an additional amount could be advantageously done at this time, particularly for the protection of the east jetty, which for the greater part of its length is a structure consisting of a single row of sheet piling. The present riprapping against it barely comes to the surface

2056 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

of the water, and when the piling gives way, due to decay, as it will very soon, the channel will not be sufficiently protected on this side. An appropriation of \$5,000 is recommended for the maintenance of this harbor.

*Money statement.*

July 1, 1902, balance unexpended .....	\$5,653.53
June 30, 1903, amount expended during fiscal year.....	5,570.91
July 1, 1903, balance unexpended .....	82.62
July 1, 1903, outstanding liabilities.....	6.71
July 1, 1903, balance available.....	75.91
Amount that can be profitably expended in fiscal year ending June 30 1905, for maintenance of improvement in addition to the balance unexpended July 1, 1903.....	
Submitted in compliance with requirements of sundry civil act of June 4, 1897, and of section 7 of the river and harbor act of 1899.	5,000.00

AMOUNT AND DATE OF ALL APPROPRIATIONS.

July 10, 1872.....	\$8,000.00	September 19, 1890.....	\$3,000.00
July 10, 1872 (allotment) ....	2,000.00	July 13, 1892.....	10,000.00
March 3, 1875.....	5,000.00	August 18, 1894.....	6,000.00
August 14, 1876.....	5,000.00	June 3, 1896.....	6,000.00
June 18, 1878.....	10,000.00	March 3, 1899.....	6,000.00
March 3, 1879.....	10,000.00	June 13, 1902.....	5,000.00
June 14, 1880.....	5,000.00	Total.....	99,000.00
March 3, 1881.....	5,000.00	Expended to June 30, 1903....	98,917.38
August 2, 1882.....	6,000.00	Unexpended July 1, 1903....	82.62
August 5, 1886.....	2,000.00		
August 11, 1888.....	5,000.00		

NOTE.—The river and harbor act of July 13, 1892, provided "that of the amount, \$1,200 are to be paid to Charles Roose, of Oak Harbor, Ohio, in full satisfaction for the necessary portion of the sand beach adjoining the inner end of the west revetment of Port Clinton Harbor."

LIST OF CONTRACTS IN FORCE DURING THE FISCAL YEAR ENDING JUNE 30, 1903.

*Contract for dredging at Port Clinton Harbor, Ohio.*

Name of contractor: The Detroit Dredging Company, Detroit, Mich.  
 Date of contract: October 9, 1902.  
 Date of approval: November 5, 1902.  
 Date of commencement: October 20, 1902.  
 Date of completion: April 4, 1903.

COMMERCIAL STATISTICS.

The following statistics for the year 1902 relative to the commerce of the harbor of Port Clinton, Ohio, were compiled from information furnished by the collector of customs and by the owners of vessels that visited the port:

Receipts.	Tons.	Shipments.	Tons.
Coal and coke .....	830	Coal and coke .....	1,249
Fish.....	1,778	Grain and produce.....	70
Lumber, logs, etc.....	5,973	Lumber, logs, etc.....	20
Merchandise.....	99	Lime, plaster, and cement.....	6
Miscellaneous.....	8	Merchandise.....	123
		Shingles.....	1
		Miscellaneous.....	1,456
Total.....	8,688	Total.....	2,925

Total freight tonnage:	
1902.....	11,613
1901.....	9,629
Increase .....	1,984

Vessels.	Number.	Tonnage.
Entering.....	76	12,116
Departing.....	74	11,429

Total registered tonnage:	
1902.....	23,545
1901.....	17,350
Increase .....	6,195

Draft of largest vessels using harbor, 15 feet.  
Largest vessels do not load to full depth.  
No new vessel lines established during the year.

### R R 3.

#### IMPROVEMENT OF SANDUSKY HARBOR, OHIO.

The present project for the improvement of this harbor represents the summation of at least two projects. The first has reference to the construction of sills, jetties, and other permanent works, designed to maintain and protect the channel. It is given in full on page 2651 and pages 2708 to 2716, inclusive, Report of Chief of Engineers, 1898. The second part of the project relates to dredging, and is given on pages 3271 to 3277, inclusive, Report of Chief of Engineers, 1901. The total estimated cost of the completion of the present project, exclusive of all previous appropriations, is \$930,000.

The river and harbor act of June 13, 1902, appropriated \$125,000 for continuing the improvement under this project. Of this sum \$40,000 was authorized to be expended toward the construction of a hydraulic dredge. The use of this machine will be of great advantage in the execution of the project and will, no doubt, effect a saving in excess of the allotment. The balance of the appropriation it is proposed to apply to the work of dredging by contract, and the amount is deemed sufficient to secure a channel 21 feet deep and 200 feet wide across the bar and inward to the docks, and of like depth and 100 feet wide throughout the length of the dock channel, except that it may be necessary to reduce the width to 60 feet for a short distance where rock may be encountered.

The first proposals received were necessarily rejected, as the prices all greatly exceeded the estimates. The second set of proposals, opened September 5, 1902, were more satisfactory, and the award was made to John J. Stang, of Lorain, Ohio. His bid, in the aggregate, corresponded with the estimate, but it was ill balanced, being too low for the rock and too high for the sand. The contract was approved October 18, 1902, but he accomplished very little work during that season.

## 2058 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

At the opening of the season of 1903 his progress was still unsatisfactory. He owned only a single dredge of very small capacity and of insufficient strength for the work. Recently he has procured additional plant and a good rate of progress is now being made.

For a detailed account of the work done, and for results of soundings in the channel, attention is respectfully invited to the report of Assistant Engineer William T. Blunt, which is transmitted herewith.

A definite project now has been adopted for a satisfactory improvement of this harbor, and economy and advantage would undoubtedly result if the funds were made available for the completion of the work.

\* \* \* \* \*

### *Money statement.*

July 1, 1902, balance unexpended .....	\$125,364.58
June 30, 1903, amount expended during fiscal year .....	3,815.10
July 1, 1903, balance unexpended .....	121,549.48
July 1, 1903, outstanding liabilities .....	8,273.00
July 1, 1903, balance available .....	113,276.48
July 1, 1903, amount covered by uncompleted contracts.....	66,020.32
Amount (estimated) required for completion of existing project .....	930,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1905, in addition to the balance unexpended July 1, 1903:	
For works of improvement.....	\$200,000.00
For maintenance of improvement.....	18,000.00
	218,000.00
Submitted in compliance with requirements of sundry civil act June 4, 1897, and of section 7 of the river and harbor act of 1899.	

### AMOUNT AND DATE OF ALL APPROPRIATIONS.

June 11, 1844 .....	\$15,000.00	July 5, 1884 .....	\$20,000.00
August 30, 1852 .....	15,000.00	August 5, 1886 .....	5,000.00
June 23, 1864 (allotment)....	10,000.00	August 11, 1888 .....	40,000.00
June 23, 1866 .....	38,580.00	September 19, 1890.....	45,000.00
June 11, 1870 .....	10,000.00	July 13, 1892 .....	41,712.00
June 10, 1872 .....	13,000.00	August 18, 1894 .....	30,000.00
March 3, 1873 .....	25,000.00	June 3, 1896 .....	40,000.00
June 23, 1874 .....	25,000.00	March 3, 1899.....	80,000.00
March 3, 1875 .....	25,000.00	June 13, 1902.....	125,000.00
August 14, 1876.....	25,000.00		
June 18, 1878 .....	20,000.00	Total .....	681,792.00
March 3, 1879.....	1,000.00	Expended to June 30, 1903..	560,242.52
July 14, 1880.....	12,500.00		
March 3, 1881.....	10,000.00	Unexpended July 1, 1903 ...	121,549.48
August 2, 1882 .....	10,000.00		

### LIST OF CONTRACTS IN FORCE DURING THE FISCAL YEAR ENDING JUNE 30, 1903.

#### *Contract for dredging at Sandusky Harbor, Ohio.*

Name of contractor: John J. Stang, Lorain, Ohio.

Date of contract: September 27, 1902.

Date of approval: October 18, 1902.

Date of commencement: November 14, 1902.

Date of completion: November 20, 1903.



## COMMERCIAL STATISTICS.

The following statistics for the year 1902, relative to the commerce of the harbor of Sandusky, Ohio, were compiled from information furnished by the collector of customs and by the owners of vessels that visited the port:

Receipts.	Tons.	Shipments.	Tons.
Fish.....	1,733	Coal and coke.....	317,233
Iron ore.....	179,410	Grain and produce.....	267
Iron, pig.....	8,500	Lumber, logs, etc.....	1,607
Lime, plaster, and cement.....	110	Merchandise.....	16,024
Lumber, logs, etc.....	67,857	Stone.....	15,737
Merchandise.....	11,613		
Salt.....	3,937		
Sand and gravel.....	191,176		
Shingles.....	47		
Stone.....	27,802		
Miscellaneous.....	14,133		
<b>Total.....</b>	<b>506,333</b>	<b>Total.....</b>	<b>350,943</b>

## Total freight tonnage:

1902.....	1,357,316
1901.....	1,188,885

<b>Increase.....</b>	<b>168,431</b>
----------------------	----------------

Vessels.	Number.	Tonnage.
Entering.....	4,232	886,947
Departing.....	4,204	870,732
Built.....	2	59

## Total registered tonnage (vessels entering and departing):

1902.....	1,757,679
1901.....	2,354,796

<b>Decrease.....</b>	<b>597,117</b>
----------------------	----------------

Draft of largest vessels using harbor, 18 feet.

Largest vessels do not load to full depth.

No new vessel lines established during the year.

## REPORT OF MR. WM. T. BLUNT, ASSISTANT ENGINEER.

TOLEDO, OHIO, July 1, 1903.

SIR: I have the honor to submit the following report upon Sandusky Harbor, Ohio, for the fiscal year ending June 30, 1903:

All depths mentioned are given at mean level of Lake Erie, 1860 to 1875, the lake surface being now about three or four tenths feet above that level.

*Condition of channels and permanent works.*—Soundings were taken over the entire length of channels in April and May, 1903. On the outer bar the channel was in good condition, following the old Cedar Point range from the lake, thence the new outer range to the Deep Hole. From the lake to outer end of jetty depths were no less than 19 feet, but quite irregular, there being several deep and extensive holes, almost exactly as found in July, 1902; thence to the Deep Hole the bottom was nearly level, at depth of 18 to 19½ feet. The bar from the westward, with 10 feet on its crest is slowly working into the cut. The bar from the eastward, with 13 feet depth, projects into the channel near its outer end in three points, with deep water between, and these points have prevented the use of the new outer range at its lake end. The depth over these points on the new range has increased since 1902, probably by passing of boats over them. On the whole, this outer-bar channel has maintained itself remarkably well and it is undoubtedly due to the jetty which is still incomplete. The extension of jetty to the 5,000-foot limit will most likely cause a material decrease in dredging expense.

## 2060 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

In the straight channel there has been the usual fill in some places and scour in others, but the axial depths remain good. There was 19 to 20 feet depth for nearly the entire length, and 18 to 18½ feet for the short portion near the inner end. There has been a resultant fill in most sections during the past year, and the resultant fill for the whole channel is at an annual rate of 0.12 foot. The following table shows the average annual rate of change in each section as indicated by various surveys since 1894, when the first dredging of this channel was completed. The details upon which this table is based will be found in annual reports for 1899 and 1900.

*Summary of average annual rates of deposit during different periods, Sandusky Harbor, Ohio.*

Period covered.	Straight channel.												General average.
	Section numbers.												
	1	2	3	4	5	6	7	8	9	10	11	12	
1894 to 1895 .....	.18	-.07	-.36	-.08	.26	.02	-.02	.31	.20	.08	.19	.....	.06
1895 to 1896 .....	.....	.22	.12	-.17	.37	.27	.30	.18	.39	.73	.73	.26	.31
1896 to 1897 .....	-.72	-.19	-.11	-.12	-.23	-.14	-.23	-.28	-.29	-.12	-.13	-.24	-.23
1897 to 1898 .....	.....	.....	.....	.....	.....	.....	.....	.01	.00	-.08	.02	.09	-.04
1898 to 1899 .....	.11	.17	.12	-.03	.07	.32	.21	.13	.20	.13	.17	.01	.12
1899 to 1900 .....	.71	.39	.13	.32	.16	.10	.10	-.06	-.16	.09	-.08	-.06	.14
1900 to 1901 .....	.70	.47	-.32	.21	.13	-.09	.60	.64	.11	.11	.70	.11	.27
1901 to 1902 .....	-.14	.23	.66	.46	.23	.27	.09	-.15	.36	.66	.38	.36	.28
1902 to 1903 .....	.43	.01	-.33	-.11	.01	.41	.32	.43	.36	.29	.13	-.47	.12
General average.	.18	.15	-.03	.06	.09	.10	.14	.13	.13	.21	.23	.01	.11

In the main dock channel there has been an average fill of 1.5 feet since dredged in 1900. The limiting depth on axis is now 17.8 feet. The dredging of 1900 was for a width of 60 feet, increased to 75 feet at upper end. Average depth after dredging was 19.6 feet; average depth May, 1902, was 18.3 feet; average depth May, 1903, was 18.1 feet.

In the west section of dock channel there has been an average fill of 2.2 feet since dredged in 1900, the limiting depth on axis being now 17 feet. The dredging was for a width of 80 feet, increased to 100 feet at the upper end. Average depth after dredging, was 19.8 feet; average depth July, 1902, was 17.4 feet; average depth May, 1903, was 17.6 feet.

The condition of the jetties, submerged dikes, and wing dike remain good except that a few stones on the jetty have been heaved up by ice. These can be readily replaced.

*Dredging.*—Contractor, John J. Stang.

A contract was entered into with John J. Stang, on September 27, 1902, providing for the dredging of the channels to a depth of 21 feet so far as funds would allow. It is expected that under this contract the required depth will be obtained over the entire length of channels from the lake to "short line" wharves, and over such widths as have already been dredged. The width of 200 feet is intended through the bar and straight channel and 100 feet through the entire dock channel, excepting that the rock cut, if such is found advisable, is to be but 60 feet wide.

The contractor was very dilatory in beginning work and has been exceedingly lax in its conduct. A small and entirely incompetent dredge was placed at work November 17, 1902, and dredged 855 yards during the balance of November, when the work was suspended for the winter. The same dredge resumed work May 13, and has continued since that time, with many delays from breakage and weather. During the entire time it has removed but 10,612 yards and covered an area of but 140 feet by 400 feet, near the end of the straight channel.

The second dredge, *Detroit Dredging Company No. 2*, began work May 18 and continued until June 30, when it was withdrawn temporarily to complete another piece of work. This dredge worked on the outer bar when possible and on the straight channel when weather was bad.

A third dredge, *G. H. Breyman & Bros. No. 2*, began June 18 and will remain until the completion of the work. It also has worked on the outer bar when possible and on the straight channel in bad weather.

A fourth dredge, *G. H. Breyman & Bros. No. 1*, began June 27 and will remain at least until the end of July.

It is thus possible that on August 1 there will be only two dredges left to complete the work, and one of them practically useless for such work.

The outer bar has been laid out in sections of 800 feet each for convenience of notation; the same as has been done on the straight channel since its inception. These sections begin 400 feet inward from the angle in east jetty, and the 21 feet natural depth is found at the middle of section 8, so that the length of cut for 21 feet depth is 6,000 feet. The outer end of completed east jetty is now 2,200 feet from its angle, and the piles left in it at each 200 feet of length are sufficiently near the section lengths to serve as marks for them. The work on outer bar has, up to June 30, been confined to the opening up of the new outer range by cutting through the shoals making in from the eastward, and to the dredging of the section where the bar makes in from the westward. Along the bank in each of these places a deep cut will be made to partially allow for filling. At the end of the year this work was nearly completed, and in a very short time the outer range will be open for its entire length.

The work on the straight channel has not yet been of such extent as to be worthy of note. Each dredge works in an isolated section, so as not to interfere with the others.

No work has been done under this contract upon the dock channel, but this channel has also been laid out in sections of 800 feet each, as before described, beginning at the east face of the Baltimore and Ohio coal wharf and being numbered westward.

Following is a tabular summary of work thus far accomplished by the dredges:

Dredge.	Outer bar.	Straight channel.	Cubic yards, per hour worked.
Stang No. 1.....		10,612	57
Detroit Dredging Company No. 2.....	18,078	10,031	113
G. H. Breymann & Bros. No. 2.....	15,885	2,765	209
G. H. Breymann & Bros. No. 1.....		2,926	126
Total .....	33,963	26,334	.....

Very respectfully,

Maj. DAN C. KINGMAN,  
Corps of Engineers.

WM. T. BLUNT,  
United States Assistant Engineer.

#### R R 4.

#### IMPROVEMENT OF HURON HARBOR, OHIO.

A description of the early conditions of the harbor at the mouth of Huron River and of the projects for its improvement is given on pages 2653 and 2654, Report of Chief of Engineers, 1898.

The river and harbor act of June 13, 1902, appropriated \$40,000 for the maintenance of this harbor. The existing project was not a satisfactory one, because the width between the jetties is too slight and the depth now authorized is insufficient. If any change is made it must be by moving the east jetty farther to the eastward. No repairs were therefore permissible upon this structure. The funds have been applied to rebuilding the shore end of the west jetty. The portion rebuilt belongs to the early period of construction and was composed of cribs small in size, of insufficient strength, and sunk on the natural bottom of the lake. It is necessary to completely remove them and to dredge a trench of proper depth and sink new cribs of approved design in their place.

The work has been carried on by hired labor, and at the close of the fiscal year a length of 368 feet of old jetty had been completely removed and new work built and sunk in place and work was in

2062 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

progress upon the construction of a continuous timber superstructure over the cribs. The funds available will probably suffice for building about 100 feet more of this work. The work was done by hired labor, which permitted certain modifications tending to economy. The costs of the finished work of this season will be about \$85 a running foot, which is much less than it could be done for by contract.

The last river and harbor act called for an examination or survey of this harbor, with a view to securing a depth of 20 feet. The preliminary examination has been made and the harbor reported worthy of a survey. An allotment of \$500 has been made for the survey, but at the close of the fiscal year the field work has not been accomplished.

For a detailed account of the construction and sinking of the cribs, and for a statement of costs and quantities, attention is respectfully invited to the report of Assistant Engineer William T. Blunt, which is transmitted herewith.

\* \* \* \* \*

*Money statement.*

July 1, 1902, balance unexpended .....	\$43,279.81
Amount allotted March 20, 1903, from act for examinations and contingencies of rivers and harbors, approved June 13, 1902 .....	500.00
July 1, 1902, balance unexpended .....	43,779.81
June 30, 1903, amount expended during fiscal year .....	28,233.28
July 1, 1903, balance unexpended .....	15,546.53
July 1, 1903, outstanding liabilities .....	1,450.00
July 1, 1903, balance available .....	14,096.53
(Amount (estimated) required for completion of existing project .....	77,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1905, in addition to the balance unexpended July 1, 1903:	
For works of improvement .....	\$77,500.00
For maintenance of improvement .....	10,000.00
	87,500.00*
Submitted in compliance with requirements of sundry civil act of June 4, 1897, and of section 7 of the river and harbor act of 1899.	

AMOUNT AND DATE OF ALL APPROPRIATIONS.

May 20, 1826 .....	\$5,000.00	June 18, 1878 .....	\$1,000.00
May 19, 1828 .....	4,413.35	June 14, 1880 .....	3,000.00
March 3, 1829 .....	5,935.00	March 3, 1881 .....	3,000.00
April 23, 1830 .....	1,880.36	August 2, 1882 .....	2,500.00
March 2, 1831 .....	3,480.00	July 5, 1884 .....	7,500.00
July 3, 1832 .....	1,500.00	August 5, 1886 .....	3,000.00
June 28, 1834 .....	6,700.00	August 11, 1888 .....	6,000.00
June 2, 1836 .....	4,300.00	September 19, 1890 .....	16,000.00
March 3, 1837 .....	2,565.00	July 13, 1892 .....	15,000.00
July 7, 1838 .....	5,000.00	August 18, 1894 .....	10,000.00
June 11, 1844 .....	5,000.00	June 3, 1896 .....	8,000.00
August 30, 1852 .....	10,000.00	March 3, 1899 .....	25,000.00
June 23, 1866 .....	39,000.00	June 13, 1902 .....	40,000.00
June 23, 1874 .....	1,500.00	March 20, 1903 .....	500.00
March 3, 1875 .....	1,000.00		
		Total .....	237,773.71
Expended to June 30, 1903 .....			222,227.18
Unexpended July 1, 1903 .....			15,546.53

## COMMERCIAL STATISTICS.

The following statistics for the year 1902 relative to the commerce of the harbor of Huron, Ohio, were compiled from information furnished by the collector of customs and by the owners of vessels that visited the port:

Receipts.	Tons.	Shipments.	Tons.
Fish.....	455	Coal and coke.....	208,145
Iron ore.....	583,124	Miscellaneous.....	11
Lumber, logs, etc.....	271	Total.....	208,156
Stone.....	3,365		
Miscellaneous.....	41		
Total.....	587,226		

Total freight tonnage:	
1902.....	795,382
1901.....	674,492
Increase.....	120,890

Vessels.	Number.	Tonnage.
Entering.....	272	829,910
Departing.....	301	842,109

Total registered tonnage:	
1902.....	672,014
1901.....	548,764
Increase.....	123,250

Draft of largest vessels using harbor, 18 feet.

Largest vessels do not load to full depth.

No new vessel lines established during the year.

## REPORT OF MR. WM. T. BLUNT, ASSISTANT ENGINEER.

TOLEDO, OHIO, *July 1, 1903.*

SIR: I have the honor to submit the following report upon Huron Harbor, Ohio, for the fiscal year ending June 30, 1903:

At the beginning of the year the superstructure over cribs Nos. 1 and 2, sunk in May, 1902 (240 feet), was completed except the placing of deck plank. This work was delayed in the expectation that the Light-House Department would place an elevated walk attached to joist as usual. As no harm came to either the pier or its stone filling, the planking has been left until the new work of 1903 shall be ready to plank, it now being understood that the walk will be of iron and will not interfere with the planking.

Under the appropriation contained in river and harbor act of June, 1902, the work of replacing the old west pier by new work has continued. In August, 1902, purchases of the necessary timber and iron were made, and the work was begun in September upon the construction of cribs of the same general design as in 1901. Some slight changes were found desirable in order to cheapen the work without in any way injuring its strength. The countersinking of boltheads was avoided where possible; driftbolts were not headed; beech instead of oak was used for sheathing, and its amount was much reduced; end walls were made 12 inches thick instead of 8 inches, and the supporting longitudinal walls were omitted; crib was made of 15 pockets of like dimensions, 8 feet on centers, and its total length was 122 feet 8 inches; calked floatage pockets were reduced from four to three, and to two in the last crib built, and it is believed that none will be necessary in future work of this design where water can be found deep enough to heel the crib over sufficiently for the placing of upper course of sheathing.

Thus Crib No. 3 was launched November 3, 1902, No. 4 December 6, 1902, and No. 5 April 22, 1903, each having been built up 17 courses. Cribs Nos. 3 and 4 were stored for the winter in the Wheeling and Lake Erie Railway slip.

## 2064 · REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

The U. S. dredge *Maumee* reached Huron May 13 and at once began clearing out old pier and making bottom for the new cribs at depth of 20 feet. The dredge remained to assist in placing of the cribs and was ready to leave the harbor June 10. Heavy weather prevented and interfered with the trip, so that the fleet did not reach Toledo until the 14th.

Crib No. 3 was sunk June 3, No. 5 June 8, and No. 4 June 10. They were filled with stone to the water surface as quickly as possible, but not before the very stormy weather of that month had slightly "kinked" them. The alignment is still, however, very good. Work proceeded on the continuous superstructure, and at the end of the year about two courses of timber remained to be placed to bring the entire length of 368 feet up to the joist line.

Preparations are being made for the expenditure of the balance of funds in the construction of a sixth crib of such dimensions as can be completed with the amount available.

There remains about 464 feet of old west pier, which is all in an advanced state of ruin.

There have been used during the year the following amounts of material:

Hemlock timber .....	feet B. M.	339, 263
Pine timber .....	do	147, 942
Beech timber .....	do	23, 877
Tie rods .....	pounds	25, 098
Screw bolts .....	do	46, 777
Hook bolts .....	do	100
Driftbolts .....	do	29, 962
Lag screws .....	do	26, 195
Washers .....	do	14, 500
Spikes .....	do	600
Stone .....	tons	4, 000

The cost of this 368 feet of pier will be about \$85 per linear foot, which will include all expense of whatever nature charged to Huron Harbor. Mr. Thomas W. Simpson, inspector in charge, has conducted the work with economy and skill. I believe the workmanship and material will compare favorably with any ever constructed.

Depths of water in the harbor have continued sufficient without any dredging, the largest vessels entering without any trouble. The United States dredge while not engaged upon pier work spent a portion of one day in removing a small shoal at the entrance to the Wheeling and Lake Erie slip. While the location is, strictly speaking, not within the limit usually cared for by the United States, the work was fully warranted by the many favors shown by the railroad company, such as free use of its land, loan of tools, and winter storage room in its slip for cribs.

Very respectfully,

WM. T. BLUNT,  
*United States Assistant Engineer.*

Maj. DAN C. KINGMAN,  
*Corps of Engineers.*

R R 5.

### IMPROVEMENT OF VERMILION HARBOR, OHIO.

For a description and history of this improvement, see page 2696, Report of Chief of Engineers, 1898.

There were no funds available for the improvement of this harbor at the beginning of the fiscal year 1903, and no improvement was contemplated. In the course of the summer a violent storm caused a breach to be made into the channel around the shore end of the east jetty. This threatened to destroy the channel by sand washed through the break. An allotment of \$400 was made by the Secretary of War from the appropriation for "Emergencies in River and Harbor Works," act of June 6, 1900, to repair the damage. The repair work was done by hired labor, making use of brush, old timber, and large

stone. The break is now completely closed and a wide extent of beach has formed in front of it.

The river and harbor act of June 13, 1902, called for an examination or survey of this harbor with a view to its future improvement.

\* \* \* \* \*

### *Money statement.*

Amount allotted August 5, 1902, from appropriation "Emergencies in River and Harbor Works," approved June 6, 1900.....	\$400.00
Amount allotted October 13, 1902, from appropriation "Examinations, Surveys, and Contingencies of Rivers and Harbors," approved June 13, 1902.....	250.00
	650.00
June 30, 1903, amount expended during fiscal year.....	400.00
July 1, 1903, balance unexpended.....	250.00

### AMOUNT AND DATE OF ALL APPROPRIATIONS.

July 2, 1836.....	\$10,000.00	July 13, 1892.....	\$2,000.00
March 3, 1837.....	20,000.00	August 18, 1894.....	2,000.00
July 7, 1838.....	23,626.57	June 3, 1896.....	1,000.00
June 28, 1864 (allotment)....	5,758.97	June 6, 1900 (al-	
June 23, 1866.....	15,315.74	lotment).....	\$1,500.00
June 10, 1872.....	5,000.00	Redeposited April	
March 3, 1873.....	12,000.00	19, 1902.....	1,323.73
June 23, 1874.....	3,000.00		176.27
March 3, 1875.....	10,000.00	August 5, 1902 (allotment) ..	400.00
August 14, 1876.....	5,000.00	October 13, 1902 (allotment) ..	250.00
June 18, 1878.....	4,000.00		
June 14, 1880.....	2,000.00	Total.....	133,527.55
March 3, 1881.....	2,000.00	Expended to June 30, 1903..	133,277.55
August 2, 1882.....	3,000.00		
August 5, 1886.....	3,000.00	Unexpended July 1,	
August 11, 1888.....	1,000.00	1903.....	250.00
September 19, 1890.....	2,000.00		

### COMMERCIAL STATISTICS.

The following statistics for the year 1902 relative to the commerce of the harbor of Vermilion, Ohio, were compiled from information furnished by the collector of customs and by the owners of vessels that visited the port:

Receipts.	Tons.	Shipments.	Tons.
Fish.....	550	Coal and coke.....	235
Lumber, logs, etc.....	875	Fish.....	200
		Lumber, logs, etc.....	262
Total.....	1,425	Total.....	697

Total freight tonnage:	
1902.....	2,122
1901.....	7,060
Decrease.....	4,928

Vessels.	Number.	Tonnage.
Entering.....	68	1,900
Departing.....	64	1,800
Built.....	2	80

## 2066 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

### Total registered tonnage:

1902 .....	3 700
1901 .....	7 900
Decrease .....	4,200

Draft of largest vessels using harbor, 14 feet.

Largest vessels do not load to full depth.

No new vessel lines established during the year.

### R R 6.

#### IMPROVEMENT OF BLACK RIVER (LORAIN) HARBOR, OHIO.

A description of the location, conditions, and projects for improvement of this harbor is given upon page 2658, Report of Chief of Engineers, 1898.

The execution of the approved project, as far as the means available will allow, is being made under a continuous contract with Patrick Keohane, of Fayetteville, N. Y., dated October 27, 1900, modified by a supplementary agreement, which provides for widening the jettied channel to 300 feet.

During the present fiscal year the contractor has built and sunk in place 1,135 linear feet of the crib substructure of the jetties. This, with the work already done, completes the substructure for the new east jetty, which is 1,762 feet in length, and in addition forms a new substructure for a length of 365 feet of the west jetty. This is all of the work of this character which is provided for in the contract and all that will be needed in the proposed improvement.

The crib substructure is excellent work of its kind. The cribs are strongly and scientifically built. Their length varies, according to the local requirements, from 128 feet to 224 feet. They are sunk in dredged channels with excellent alignment and upon a foundation which has been leveled up with small stone. A total length of 729 feet of the concrete superstructure of the east jetty has been built. The material is excellent and the concrete first class. The two timber cribs for the substructure of the pierheads of the breakwater have been partially completed, but have not been sunk in place. The old east pier has been completely removed, and the channel has been dredged to a depth of 21 feet, except for a width of about 40 feet along the east jetty, where work is still in progress. The amount of dredging necessary to accomplish this result exceeded the estimate, and this is doubtless due to the material carried into the channel while openings existed during the construction of the jetties.

A small amount of stone, less than 10,000 tons in the aggregate, has been placed in the substructure of the west breakwater. All of the work done under contract is good, but the progress has been unsatisfactory. Sixteen working months out of the thirty allowed by the contract have already elapsed, and only a little more than one-third of the work has been accomplished. Every effort has been made to induce the contractor to increase his rate of progress. His plant is good of its kind but insufficient in quantity, and his labor force is always too small.

The complete project for the improvement of this harbor provides for the construction of an east breakwater 1,500 feet in length. The funds appropriated were not sufficient to permit this to be included in



the contract. Provision should be made for its construction in order that there may be no delay in the completion of the whole project. The estimated cost of this work is \$190,000.

The plan for the improvement of this harbor provided for the complete rebuilding of a section 365 feet in length of the west jetty, this to have a concrete top. No provision was made for the maintenance of the remaining 645 feet of this jetty. The substructure of this portion is in fairly good condition and by strengthening and protecting it with a sheathing of hard-wood plank, both on the lake and channel sides, it could be made thoroughly good. The superstructure is of timber and is rapidly decaying and will very soon be entirely unserviceable. This should be renewed in concrete so as to make it conform to the rest of the work. The estimated cost of this work, which is strictly maintenance work, is, in round numbers, \$50,000, and this amount ought to be available without delay.

The harbor of Lorain is rapidly growing in importance, and extensive improvements are being made by the city of Lorain and by private companies. The United States Steel Corporation is adding to its plant and proposes an expenditure of about \$8,000,000. The city of Lorain has appropriated \$200,000 to be applied in widening and straightening the river from the shore line up to the works of the steel corporation, and the latter company proposes to enlarge the basin at their works, and has applied for permission to dump some 40,000 cubic yards of dredged shale in the lake.

The commerce of the harbor shows a very decided increase. The receipts and shipments for the calendar year 1902 amounted to 2,549,496 tons, an increase of nearly 1,500,000 tons over that of the previous year. There is a very large shipyard at Lorain, and ten steel ships were launched there last year, their aggregate tonnage being nearly 45,000 tons.

For a description of the work done during the present fiscal year, attention is respectfully invited to report of Assistant Engineer G. T. Nelles, which is transmitted herewith.

\* \* \* \* \*

#### *Money statement.*

July 1, 1902, balance unexpended .....	\$406, 832. 74
Amount appropriated by sundry civil act approved March 3, 1903 .....	9, 000. 00
	415, 832. 74
June 30, 1903, amount expended during fiscal year .....	106, 328. 05
	July 1, 1903, balance unexpended .....
	309, 506. 69
July 1, 1903, outstanding liabilities .....	5, 602. 19
	July 1, 1903, balance available .....
	303, 904. 50
July 1, 1903, amount covered by uncompleted contracts .....	290, 303. 48
	Amount (estimated) required for completion of existing project .....
	356, 000. 00
Amount that can be profitably expended in fiscal year ending June 30, 1905, in addition to the balance unexpended July 1, 1903:	
For works of improvement .....	\$300, 000. 00
For maintenance of improvement .....	55, 000. 00
	355, 000. 00
Submitted in compliance with requirements of sundry civil act of June 4, 1897, and of section 7 of the river and harbor act of 1899.	

# 2068 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

## AMOUNT AND DATE OF ALL APPROPRIATIONS.

May 23, 1828.....	\$7,500.00	March 3, 1881.....	\$7,000.00
April 23, 1830.....	8,559.77	August 2, 1882.....	7,000.00
March 2, 1831.....	9,275.00	July 5, 1884.....	10,000.00
July 3, 1832.....	8,000.00	August 5, 1886.....	10,000.00
March 2, 1833.....	2,400.00	August 11, 1888.....	10,000.00
June 28, 1834.....	5,000.00	September 19, 1890.....	12,000.00
March 3, 1835.....	4,400.00	July 13, 1892.....	20,000.00
July 2, 1836.....	6,660.00	August 18, 1894.....	10,000.00
March 3, 1837.....	6,410.00	June 3, 1896.....	30,000.00
July 7, 1838.....	5,000.00	March 3, 1899.....	50,000.00
August 30, 1852.....	5,000.00	June 6, 1900.....	125,000.00
June 28, 1864 (allotment)....	20,000.00	June 13, 1902.....	6,000.00
June 23, 1866.....	10,000.00	June 28, 1903.....	300,000.00
June 10, 1872.....	20,000.00	March 3, 1903.....	9,000.00
March 3, 1873.....	20,000.00		
June 23, 1874.....	20,000.00	Total.....	782,204.77
March 3, 1875.....	10,000.00	Expended to June 30, 1903..	472,698.08
August 14, 1876.....	6,000.00		
June 18, 1878.....	1,000.00	Unexpended July 1,	
June 14, 1880.....	1,000.00	1903.....	309,506.69

## LIST OF CONTRACTS IN FORCE DURING THE FISCAL YEAR ENDING JUNE 30, 1903.

*Contract for constructing west breakwater, two pierheads, removing and rebuilding parts of east and west piers.*

Name of contractor: Patrick Keohane, Fayetteville, N. Y.

Date of contract: October 27, 1900.

Date of approval: November 22, 1900.

Date of commencement: April 1, 1901.

Date of completion: Continuous contract.

## COMMERCIAL STATISTICS.

The following statistics for the year 1902, relative to the commerce of the harbor of Black River (Lorain), Ohio, were compiled from information furnished by the collector of customs and by the owners of vessels that visited the port:

Receipts.	Tons.	Shipments.	Tons.
Fish.....	394	Coal and coke.....	861,739
Iron ore.....	1,605,421	Iron and steel (structural).....	7,677
Lumber, logs, etc.....	16,299	Sand and gravel.....	2,160
Sand and gravel.....	19,500	Miscellaneous.....	1,756
Stone.....	32,700		
Miscellaneous.....	1,850		
Total.....	1,676,164	Total.....	873,332

### Total freight tonnage:

1902.....2,549,496

1901.....1,101,551

Increase.....1,447,965

Vessels.	Number.	Tonnage.
Entering.....	526	918,158
Departing.....	515	956,760
Built.....	10	44,721

Total registered tonnage (vessels entering and departing):	
1902 .....	1,873,913
1901 .....	1,053,560
Increase .....	820,353

Draft of largest vessels using harbor, 20 feet.

Largest vessels do not load to full depth.

No new vessel lines established during the year.

REPORT OF MR. G. T. NELLES, ASSISTANT ENGINEER.

CLEVELAND, OHIO, June 30, 1903.

MAJOR: I have the honor to submit the following report of operations carried on under my local charge, at Lorain Harbor, Ohio, during the fiscal year ending June 30, 1903.

This work is being executed under a continuous contract with Patrick Keohane, of Fayetteville, N. Y., dated October 27, 1900, and a supplementary agreement, which provides for the widening of the jettied channel to 300 feet, dated August 8, 1901, all at a total estimated cost of \$460,856.56.

*Pier construction.*—Five of the substructure cribs for the east pier had been sunk in place previous to June 30, 1902. The remaining four cribs for this pier and the two cribs for the west pier have since been completed and sunk in place. The total length of the new east pier is 1,762 feet, and of the reconstructed portion of the west pier 365 feet.

The following statement gives the dimensions and history of all the substructure cribs comprised in this contract, and is arranged to show the position of the cribs in the work:

Crib No.	Dimensions.	Completed.	Sunk in place.
<b>EAST PIER.</b>			
4	20 by 224 feet (lake end) .....	May 6, 1902	May 7, 1902
3	20 by 224 feet .....	Nov. 19, 1901	Mar. 21, 1902
2	20 by 224 feet .....	Oct. 21, 1901	Oct. 31, 1901
1	20 by 192 feet .....	Sept. 20, 1901	Sept. 21, 1901
6	20 by 128 feet .....	June 4, 1902	June 9, 1902
6	20 by 192 feet .....	June 24, 1902	July 31, 1902
7	20 by 192 feet .....	July 17, 1902	Aug. 25, 1902
8	20 by 192 feet .....	Aug. 4, 1902	Oct. 5, 1902
9	20 by 192 feet (shore end) .....	Sept. 4, 1902	Oct. 20, 1902
<b>WEST PIER.</b>			
2	20 by 171 feet (outer crib) .....	Oct. 31, 1902	May 14, 1903
1	20 by 194 feet (inner crib) .....	Dec. 10, 1902	June 4, 1903

The beach at the shore end of the east pier has cut back nearly one hundred feet since the work was planned, and after completing the substructure it became necessary to connect the end of this pier with the shore by means of a riprap filling. The material and labor for this purpose was purchased in the open market. The riprap protection thus made has not proved entirely satisfactory, because it was too low and too open to prevent the wash of the sea over and through it, and it now appears necessary, in order to insure a proper shore connection to raise the fill already made with small stone and pave its slopes with large squared paving stones in practically the same manner as proposed for the west breakwater.

The grillage bottoms for the east and west breakwater pierheads were completed more than a year ago; very little work has been done on them since and they are now practically in the same condition as then reported.

The manufacture of concrete blocks, for the superstructure of the east pier, was commenced in June, 1902, and the first mass concrete work was done in July. This work has since been carried on in a very desultory manner, completing the superstructure of Cribs Nos. 1, 2, and 5; the south, 148 feet of Crib No. 3, and the north, 36 feet of Crib No. 6, a total of 729 linear feet.

# 2070 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

The following is a record of all the concrete made during the fiscal year, the proportions used being 1 cement, 2 sand, 3 gravel, and 4 broken stone:

Materials used.	Concrete blocks.	Concrete in mass.
	Cu. yds. a 177	Cu. yds. b 318
Cement (Medusa & Lagerdorfer) .....	177	318
Beach sand (25 per cent voids) .....	354	636
Beach gravel (32 per cent voids) .....	531	954
Broken limestone (50 per cent voids) .....	708	1,272
Total volume of materials .....	1,770	3,180
Resulting volume of concrete .....	1,221	2,124

a 1,192 barrels.

b 2,141 barrels.

Ratio of volume of concrete to volume of materials used, concrete blocks, 69 per cent; concrete in mass, 66.8 per cent.

One barrel of cement has been required for each cubic yard of concrete made. All of this concrete has been mixed so wet that very little tamping has been necessary to settle it to place and fill all the voids. The finished surfaces of both the mass concrete and the blocks has been obtained by tamping and manipulating the concrete itself, and not, as is usually the case, by plastering the molds.

The removal of the old east and west piers has been completed, and the jettied channel has all been excavated to a depth of 21 feet, except over a strip about 40 feet wide, along the east pier, where the depth is only 17 feet. The quantity of dredging necessary to accomplish this has materially exceeded our estimates, because of the cutting away of the beach at the shore end of the east pier, a large proportion of this material having been carried into the channel.

*Breakwater construction.*—Notwithstanding the repeated promises of the contractor to push this branch of his work during the present fiscal year at a rate of not less than 20,000 tons per month, practically nothing has been done. During the fall of 1902 but 2,491 tons of large riprap stone and 3,246.4 tons core filling was deposited the west breakwater; during the present season no large riprap and but 3,477 tons of small stone taken from the old east pier has been delivered and used for core filling. The total for the whole fiscal year is 9,212.4 tons, or less than one-half of what was promised per month.

The character, quantity, and value of the labor and materials furnished by the contractor during the fiscal year, and the totals since the beginning of the contract, for which payment has been made, is as follows:

Material, etc.	During fiscal year 1903.		Total to June 30, 1903.	
	Quantity.	Cost.	Quantity.	Cost.
Hemlock timber, \$22 per 1,000 feet B. M. ....	1,231.787	\$27,099.31	2,297.961	\$50,554.92
Oak timber, \$38 per 1,000 feet B. M. ....	108.422	4,120.04	204.614	7,775.33
Filling and foundation stone, \$0.89 per ton .....	16,722.8	14,883.29	28,005.69	24,925.06
Heavy riprap for breakwater, \$0.90 per ton .....	2,489	2,240.10	2,489	2,240.10
Core filling for breakwater, \$0.70 per ton .....	6,723.4	4,706.38	7,458.3	5,220.81
East pier removed, \$4.10 per linear foot .....	975	3,997.50	1,578	6,469.80
West pier removed, \$4.10 per linear foot .....	365	1,496.50	365	1,496.50
Concrete blocks made, \$0.37 per linear foot .....	25,122.09	9,295.17	25,122	9,295.17
Concrete in mass, \$7.30 per cubic yard .....	2,115.94	15,446.36	2,115	15,446.36
Dredging, \$0.19 per cubic yard .....	83,993	15,958.67	119,913	22,783.47
Tie rods and washers, \$0.035 per pound .....	83,070	2,907.45	156,490	5,477.15
Drift bolts, \$0.055 per pound .....	81,216	2,842.56	150,570	5,269.95
Screw bolts and washers, \$0.035 per pound .....	93,432	3,270.12	177,342	6,206.97
Lag and washers, \$0.04 per pound .....	119,058	4,762.32	228,762	9,150.48
Spikes, \$0.04 per pound .....	2,436	97.44	3,769	150.76
Total .....		118,123.21		172,462.83

*General.*—The contract requires the completion of the whole work in thirty working months. Sixteen working months, or 53.3 per cent of the total time allowed, has already expired, while but 37.4 per cent of the contract, as measured by the value of the work done, has been completed. At this rate of progress twenty-seven months will yet be necessary to complete the contract.

The superstructure of the parts of the old west pier, not included in the present contract, is in a very dilapidated condition, is deteriorating rapidly, and will soon require extensive repairs. On this account, and in order to make this pier of uniform appearance and strength throughout, it is desirable that it should receive a concrete

superstructure similar to that on the other portions of these jetties. Both faces of the substructure cribs should be sheathed with 3-inch planking at the same time.

The cost of rebuilding the superstructure with concrete and sheathing both faces of the old substructure cribs with 3-inch beech is estimated as follows:

Tearing out old cribs and preparing same for superstructure, 645 linear feet, at \$10 per linear foot.....	\$6, 450. 00
Mass concrete for superstructure, 2,200 cubic yards, at \$9 per cubic yard..	19, 800. 00
Concrete blocks for superstructure, 900 cubic yards, at \$12 per cubic yard..	10, 800. 00
Sheathing with 3-inch beech plank, 62,880 feet B. M., at \$130 per 1,000 feet B. M .....	8, 174. 40
Supervision and contingencies, 10 per cent .....	4, 522. 44
<b>Total.....</b>	<b>49, 746. 84</b>

In order to secure the location of the United States Steel Corporation's new tube mills and a consequent expenditure of about \$8,000,000, the city of Lorain has voted bonds to the amount of \$200,000 to be used for straightening and widening the Black River up to the Steel Corporation's plant. Bids for this work have already been received, and it will doubtless be placed under contract in a short time.

The United States Steel Corporation proposes to enlarge the turning basin at their works, and permission has been asked to dump in the lake 40,000 cubic yards of shale thus excavated.

Observations have been in progress throughout the year to determine the flow and quantity of sediment carried out into the lake by the Black River, and these observations will be made the subject of a special report.

The work at Lorain has been carried on under the local supervision of Inspector Alexander J. Savord.

Very respectfully,

Maj. DAN C. KINGMAN,  
*Corps of Engineers.*

G. T. NELLES,  
*United States Assistant Engineer.*

## R R 7.

### IMPROVEMENT OF CLEVELAND HARBOR, OHIO.

For a brief history of the early conditions and projects of improvement see pages 2661 and 2662 of the Report of Chief of Engineers, 1898, and pages 530 and 531 of the Report of Chief of Engineers, 1899.

Work is now being carried on under three projects of recent date. The first of these is given in the Report of Chief of Engineers for 1896, pages 2949 to 2953, inclusive. The object of this project was to provide for building a new west jetty at the mouth of the Cuyahoga River and for completely rebuilding the east jetty, and for deepening the channel between them; also for rebuilding the superstructure of the west breakwater in concrete, and for repairing and extending the east breakwater. The total estimated cost of the work was \$1,354,000, and a continuous contract was authorized for its execution. Under this contract the east jetty has been renewed and the west jetty north of the Lake Shore Railroad bridge has been rebuilt, and the channel between them has been dredged out. Work on the west jetty has not been extended south of the bridge, nor has the channel been widened south of this structure, because title to the land which it would be necessary to remove has never been conveyed to the United States. It does not seem best to undertake this work now. It lies within the original shore line of the lake, and may very properly be left to the city of Cleveland. The cost of the work south of the Lake Shore bridge would have been about \$35,000.

The river and harbor act of June 13, 1902, forbade the further

extension of the shore arm of the east breakwater. There remained about 270 feet of this structure to build. This work, if it had been completed, would have cost about \$45,000.

The work of renewing the superstructure of the west breakwater has well advanced and will doubtless be completed this season. This will leave nothing to be done under the project except to complete the repairs to the east breakwater, which is now being done by hired labor. The funds authorized to be expended will be more than sufficient for the work.

The second project is more in the nature of maintenance, and provides for dredging in the channels and sheltered areas to a depth of 21 feet. (See Report of Chief of Engineers, 1899, pp. 3061, 3075-3078, inclusive.)

This project was enlarged by the act of Congress of June 13, 1902, so as to permit dredging to a depth of 25 feet. The total estimated cost of the work was \$478,400, of which \$105,000 is either expended or under contract, leaving \$373,400 as the amount necessary to complete this project. The greater portion of the area sheltered by the east breakwater has been deepened to 21 feet, and work is now in progress to deepen the channel between the jetties from the Lake Shore bridge northward to their outer extremity and thence across the harbor to the entrance to the breakwater. This work is less than one-half completed.

The third project provides for securing a safer and better entrance at the main entrance in the breakwater, and for extending the main breakwater eastward. (See Report of Chief of Engineers, 1901, pp. 3289-3293, inclusive.)

The project therein set forth was modified by the act of Congress of June 13, 1902, which sanctioned it by providing that the breakwater extension should be made eastward in prolongation of the line of the existing breakwater, and not on a line parallel to this and drawn from the inner end of the shore arm. The effect of this change is to set the new breakwater 900 feet farther out into the lake and to include about 300 additional acres in the sheltered area. The act which sanctioned the project appropriated \$500,000 and authorized, in addition, an expenditure of \$2,300,000 for prosecuting the improvement. Specifications were prepared for the execution of the work by contract, and proposals were opened August 28, 1902. The prices bid were unreasonably high. The aggregate amount of the lowest bids for the work which it was proposed to do exceeded the amount available by nearly \$300,000. Bids were rejected and new proposals invited after some slight modifications in the section of the breakwaters proposed. The most important modification consisted in making use of lake sand for that portion of the core of the structure which was below a depth of 20 feet in the lake. The sand is entirely covered up and protected with stone. The form of cross section and the material used is as shown in the accompanying drawing.

Some of the would-be bidders claimed that they had difficulty in securing stone, and authority was obtained to permit them to quarry stone on an island in Lake Erie belonging to the United States. The island is known as West Sister Island, and is in the western part of the lake. The effect of these things was to secure much more favorable proposals. The aggregate of the lowest bid showed a saving of more than \$508,000 over the best bid received at the former opening. The successful bidders, however, do not propose to use the stone from

West Sister Island, but the price of stone is much lower than in the former bids. Contracts were awarded for the new entrance to the L. P. & J. A. Smith Company, of Cleveland, Ohio, and for the breakwater extension, in two separate contracts, to Hughes Brothers & Bangs, of Syracuse, N. Y.

The work during the fiscal year, which involved an expenditure of \$121,978.82, has consisted in continuing work on the superstructure of the west breakwater, in repairing the east breakwater, in dredging, and in preliminary work under the new project. At the beginning of the fiscal year a contract was still in force for the completion of the old east breakwater. As this was forbidden by Congress, a supplementary agreement was made with the contractor to terminate the contract, and this was done.

One of the great difficulties attending the work of improving the harbor at Cleveland is due to the fact that the United States is entirely without wharves or convenient landing facilities. There is no place to store material except on the jetties or breakwater, and there are no wharves which the United States controls for the use and occupancy of the floating plant. The United States owns in Cleveland a tract of ground used for the Marine Hospital. This ground borders on the lake and is situated just east of Erie street. When the proposed improvements are completed this frontage will be very nearly in the center of the harbor and will be an extremely valuable piece of property. The city is already filling in and constructing wharves out to the harbor line just west of Erie street, and no doubt as soon as the new breakwater affords sufficient protection other wharves will be built, either by the city or private companies—probably by the former—eastward to the extreme end of the proposed harbor, and adequate trackage will be arranged on the made land to accommodate all railroads which come to the city, and to afford them convenient access to the wharves.

The frontage on the lake at the marine-hospital site is about 700 feet. If the United States should improve it by the construction of wharves and slips terminating on the harbor line, and by filling in to the shore, it would afford an admirable location for an engineer depot, with suitable wharf room for the new dredge which is about to be constructed for this district, and for all other floating plant used in connection with the work. There would also be sufficient wharf front for a light-house depot, and for use of the Revenue-Cutter and the Custom-House Service generally, and for the use of the Navy Department. The excavation in the slips and advance of the harbor line, and elsewhere in the inclosed area in the old harbor, would afford more than sufficient material to make the fill, and the cost of the improvement would be small in comparison with its great value. There would be 15 or 20 acres of made land south of the slips, which would be worth not less than \$40,000 an acre.

I would suggest the construction of two slips 150 feet wide and 700 feet deep, with wharves upon each side of them. This would afford 2,800 linear feet of wharf front, not counting the inner ends of the slips. It is not necessary that this entire improvement should be made at once. Without submitting it as an estimate of cost, I should say that the probable total outlay, supposing all the work to be constructed of a permanent and durable character, would be \$500,000, and an appropriation of a portion of this sum could be expended now to the great advantage of the public service.

For a detailed description of the work done at this harbor during the

# 2074 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

past year, and for a statement of cost and quantities of material used, attention is respectfully invited to the report of Asst. Engineer G. T. Nelles, which is transmitted herewith.

\* \* \* \* \*

## Money statement.

July 1, 1902, balance unexpended .....	\$800,369.93
Amount appropriated by sundry civil act approved March 3, 1903 .....	227,500.00
Collections on account of damages to west pier:	
September 6, 1902.....	\$77.44
March 6, 1903.....	200.00
	<u>277.44</u>
	1,028,147.37
June 30, 1903, amount expended during fiscal year .....	<u>121,978.82</u>
July 1, 1903, balance unexpended .....	906,168.55
July 1, 1903, outstanding liabilities .....	<u>34,789.33</u>
July 1, 1903, balance available .....	871,379.22
July 1, 1903, amount covered by uncompleted contracts.....	<u>2,593,652.31</u>
Amount (estimated) required for completion of existing project.....	4,294,356.00
Amount that can be profitably expended in fiscal year ending June 30, 1905, in addition to the balance unexpended July 1, 1903:	
For works of improvement .....	\$1,000,000.00
For maintenance of improvement .....	40,000.00
	<u>1,040,000.00</u>
Submitted in compliance with requirements of sundry civil act of June 4, 1897, and of section 7 of the river and harbor act of 1899.	

## AMOUNT AND DATE OF ALL APPROPRIATIONS.

March 3, 1825 .....	\$5,000.00	March 3, 1879 .....	\$100,000.00
March 2, 1827 .....	10,000.00	June 14, 1880 .....	125,000.00
March 3, 1829 .....	12,179.00	March 3, 1881 .....	200,000.00
April 23, 1830 .....	1,786.58	August 2, 1882 .....	175,000.00
March 2, 1831 .....	3,760.00	July 3, 1884 .....	100,000.00
July 3, 1832 .....	6,600.00	August 5, 1886 .....	93,750.00
June 28, 1834 .....	13,315.00	August 11, 1888 .....	100,000.00
July 2, 1836 .....	15,006.59	September 19, 1890 .....	75,000.00
March 3, 1837 .....	10,000.00	July 13, 1892 .....	100,000.00
July 7, 1838 .....	51,836.00	August 18, 1894 .....	50,000.00
June 11, 1844 .....	25,000.00	June 3, 1896 .....	80,000.00
August 30, 1852 .....	30,000.00	June 4, 1897 .....	350,000.00
March 3, 1853 .....	145.69	July 1, 1898 .....	294,000.00
June 28, 1864 (allotment)...	20,000.00	March 3, 1899 .....	175,000.00
June 23, 1866 .....	59,806.00	June 6, 1900 .....	175,000.00
June 25, 1868 (allotment)...	17,000.00	June 13, 1902 .....	625,000.00
April 10, 1869 (allotment)...	13,380.00	June 28, 1902 .....	107,000.00
July 11, 1870 .....	20,000.00	March 3, 1903 .....	227,500.00
March 3, 1871 (allotment for repairs).....	636.77	September 6, 1902 (received on account of damages to west jetty) .....	77.44
March 3, 1873 .....	1,000.00	March 6, 1903 (received on account of damages to west jetty) .....	200.00
June 24, 1874 .....	30,500.00		
Total previous to adoption of project of harbor of refuge .....	346,881.61	Total .....	3,707,409.05
March 3, 1875 .....	50,000.00	Expended to June 30, 1903.	<u>2,801,240.50</u>
August 14, 1876 .....	50,000.00		
August 14, 1876 (repair of pier) .....	8,000.00	Unexpended July 1, 1903 .....	906,168.55
June 18, 1878 .....	100,000.00		



## LIST OF CONTRACTS IN FORCE DURING THE FISCAL YEAR ENDING JUNE 30, 1903.

*Contract for repair of west breakwater.*

Name of contractor: Hunkin Brothers, Cleveland, Ohio.  
Date of contract: April 28, 1897.  
Date of approval: May 19, 1897.  
Date of commencement: August 3, 1897.  
Date of completion: Continuous contract.

*Contract for construction of east pier, removing parts of the west pier, dredging, and completing east breakwater.*

Name of contractor: The L. P. & J. A. Smith Company, Cleveland, Ohio.  
Date of contract: July 16, 1898.  
Date of approval: August 11, 1898.  
Date of commencement: August 15, 1898.  
Date of completion: July 24, 1902.

*Contract for dredging in Cleveland Harbor, Ohio.*

Name of contractor: The L. P. & J. A. Smith Company, Cleveland, Ohio.  
Date of contract: August 27, 1902.  
Date of approval: October 3, 1902.  
Date of commencement: October 24, 1902.  
Date of completion: February 26, 1903 (waived).

*Contract for improvement and enlargement of Cleveland Harbor, Ohio, eastern division.*

Name of contractor: Hughes Brothers & Bangs, Syracuse, N. Y.  
Date of contract: November 20, 1902.  
Date of approval: December 30, 1902.  
Date of commencement: April 1, 1903.  
Date of completion: Continuous contract.

*Contract for improvement and enlargement of Cleveland Harbor, Ohio, western division.*

Name of contractor: Hughes Brothers & Bangs, Syracuse, N. Y.  
Date of contract: November 20, 1902.  
Date of approval: December 30, 1902.  
Date of commencement: April 1, 1903.  
Date of completion: Continuous contract.

*Contract for improvement of main entrance to Cleveland Harbor, Ohio.*

Name of contractor: The L. P. & J. A. Smith Company, Cleveland, Ohio.  
Date of contract: November 19, 1902.  
Date of approval: January 9, 1903.  
Date of commencement: April 1, 1903.  
Date of completion: Continuous contract.

# 2076 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

## COMMERCIAL STATISTICS.

The following statistics for the year 1902 relative to the commerce of the harbor of Cleveland, Ohio, were compiled from information furnished by the collector of customs and by the owners of vessels that visited the port:

Receipts.	Tons.	Shipments.	Tons.
Coal and coke.....	1,200	Coal and coke.....	2,504,705
Fish.....	2,383	Fish.....	16
Flour.....	1,748	Flour.....	19,397
Grain and produce.....	104,237	Grain and produce.....	9,600
Iron ore.....	6,263,267	Iron, pig.....	1,502
Iron, pig.....	7,438	Iron and steel, structural.....	14,499
Iron and steel, structural.....	1,908	Lime, plaster, and cement.....	1,016
Lime, plaster, and cement.....	13,796	Lumber, logs, etc.....	19,931
Lumber, logs, etc.....	439,180	Merchandise.....	299,005
Merchandise.....	117,874	Salt.....	530
Salt.....	1,531	Sand and gravel.....	1,500
Sand and gravel.....	51,551	Stone.....	5,258
Shingles.....	5,472	Miscellaneous.....	44,890
Stone.....	214,822		
Miscellaneous.....	2,750		
Total.....	7,229,157	Total.....	2,921,849

Total freight tonnage:	
1902.....	10,161,005
1901.....	7,484,810
Increase.....	2,666,196

Vessels.	Number.	Tonnage.
Entering.....	4,277	4,641,550
Departing.....	4,452	4,886,141
Built.....	17	46,080

Total registered tonnage (vessels entering and departing):	
1902.....	9,527,691
1901.....	8,093,666
Increase.....	1,434,025

Draft of largest vessels using harbor, 20 feet.

Largest vessels do not load to full depth.

New vessel lines established, as follows: The Hawgood Transit Company, The Erie Steamship Company, The Franklin Transportation Company, The Bransford Transit Company, The Cleveland Steamship Company, The Acme Transit Company, The Keller Transit Company, The Steel Steamship Company, The Richardson Transportation Company, all of Mentor, Ohio.

## REPORT OF MR. G. T. NELLES, ASSISTANT ENGINEER.

CLEVELAND, OHIO, June 30, 1903.

MAJOR: I have the honor to submit the following report of operations carried on under my local supervision at Cleveland Harbor, Ohio, during the fiscal year ending June 30, 1903.

*West breakwater repairs.*—This work is being executed at a total estimated cost of \$434,575.52, by Hunkin Brothers, of Cleveland, Ohio, under a continuous contract, dated April 28, 1897, and three supplementary agreements, dated, respectively, August 25, 1897, May 31, 1898, and February 7, 1899.

The progress under this contract during the past year has not been at all satisfactory. The contractors claim this to have been mainly due to the difficulties and delays experienced by them in preparing the cribs, injured by the wreck of whaleback barge on November 10 and 11, 1898, for the new superstructure. The gap in the west breakwater, made by the whaleback, was filled up with large riprap stone shortly after the accident, and before the removal of this stone could be undertaken

it was necessary to dredge out along the harbor face of the break, in order to provide sufficient depth for the contractor's plant. After the large riprap stone had been removed the headway was particularly slow, because all of the remaining materials were small and had to be removed by hand by the aid of divers. This part of the work was greatly interfered with by strong currents that set in through the gap with each change in the lake level.

Old Crib No. 97 was built up from about 7 feet below mean lake level by divers; this method proved so unsatisfactory that old Crib No. 98 was brought up to the required grade by means of an auxiliary crib sunk on top of it. This method will also be followed in building up the remaining two old cribs requiring this treatment.

The cost of the extra work involved in building up and preparing these old cribs (Nos. 97 and 98) for superstructure has been \$10,458.98, or nearly \$105 per linear foot, which is about the same as the cost of the new cribwork for the east break-water extension.

The work completed during and to the end of the present year is as follows:

Designation.	Completed during fiscal year 1903.	Total completed to June 30, 1903.
Old superstructure removed.....linear feet..	320	5, 107
Concrete base completed.....do.....	335	5, 026. 73
Concrete parapet completed.....do.....	531	4, 726. 13
Oak fender, completed on harbor side.....do.....		4, 471
Oak sheathing completed on lake side (to old Crib No. 85).....do.....	300	4, 236. 65
Concrete blocks made.....number.....	57	1, 563
Concrete blocks set.....do.....	94	1, 516

The character, quantity, and value of the labor and materials expended during the fiscal year for which payment has been made is as follows:

Material, etc.	Quantity.	Price per unit.	Value.
White-oak timber.....M feet B. M. .	22, 534. 6	\$139. 00	\$3, 132. 31
Hemlock timber.....do.....	12, 880	17. 25	222. 19
Old timber.....do.....	29, 193	9. 85	287. 55
Concrete blocks.....cubic feet..	14, 573. 8	. 49	7, 189. 74
Concrete in place.....cubic yards..	2, 892. 19	5. 32	15, 390. 29
Lag screws.....pounds.....	3, 965	. 03	118. 95
Screw bolts.....do.....	1, 450	. 03	43. 50
Iron rods.....do.....	2, 598	. 13	337. 74
Mooring rings.....do.....	385	. 10	38. 50
Wire nails.....do.....	500	. 05	25. 00
Iron bolts set in masonry.....do.....	3, 400	. 06	204. 00
Hemlock timber (raising cribs in break).....M feet B. M. .	38, 707	40. 00	1, 548. 28
Bolts (raising cribs in break).....pounds.....	5, 717	. 03	171. 51
Filling stone (raising cribs in break).....cubic yards..	743. 9	2. 40	1, 785. 36
Riprap stone (filling between cribs).....do.....	2	3. 00	6. 00
Diver and crew preparing cribs for superstructure.....hours.....	82	3. 24	265. 68
Labor, repairing break, raising and reinforcing old cribs 97 and 98.....			3, 254. 89
Dredging along harbor face of break.....			1, 569. 00
Total.....			35, 590. 49

The total value of all work done under this contract to June 30, 1903, is \$394,980.18, leaving work to the value of \$39,395.34 yet to be accomplished.

*Constructing west pier, dredging, and completing east breakwater.*—This work was executed by the L. P. & J. A. Smith Company, of Cleveland, Ohio, under a continuous contract dated July 2, 1898, and supplementary agreements dated, respectively, September 8, 1899, June 5, 1901, October 6, 1901, and July 24, 1902.

Under the original plans it was intended to extend the west pier and entrance channel to and beyond the Lake Shore Railway bridge, but owing to legal complications concerning the right of way this was not possible. It was also intended to extend the east breakwater 3,000 feet and terminate the main harbor opposite the foot of Murison street. This extension, however, was stopped by a provision of the last river and harbor bill, which stipulates that there shall be no further extension of the deflected portion of the east breakwater beyond what had already been constructed. In order to carry out this provision of the bill it was decided to terminate the contract, which was done by supplementary agreement dated July 24, 1902. At

## 2078 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

this time there still remained to be done the work on the west pier at the Lake Shore Railway bridge, 270 linear feet of east breakwater extension and 2,200 linear feet of under-water sheathing on the outside of the old east breakwater.

The only work done under this contract during the present fiscal year for which payment has been made has been to finish up the riprap protection of the cribs already in place and to fasten some of the iron straps not previously bolted; the cost of this work was \$406.45.

The cost of the west pier, not including dredging or buttress crib for United States storehouse, was about \$75 per linear foot, and of east breakwater extension, not including foundations, \$100 per linear foot.

The character, quantity, and value of all the materials and labor furnished under this contract are as follows:

Quantity.	Material.	Price.	Value.
6,507,076	Hemlock timber.....feet B. M.	\$15.50 per 1,000 feet B. M.	\$100,859.68
1,674	do.....do.....do	do	a 32.43
2,541,403	White-pine timber.....do	\$25 per 1,000 feet B. M.	63,535.08
39,705	do.....do.....do	do	a 1,240.78
401,882	White-oak timber (sheathing on new work), feet B. M.	\$40 per 1,000 feet B. M.	16,075.28
14,255	White-oak timber (sheathing on old work), feet B. M.	\$50 per 1,000 feet B. M.	712.75
5,174	do.....do.....feet B. M.	do	a 323.38
104,367	White-oak timber.....do	\$30 per 1,000 feet B. M.	3,131.01
3,204	do.....do.....do	do	a 120.15
11,368	White-oak piles.....linear feet	\$0.25 per linear foot	2,842.00
541,968	Tie-rods and washers.....pounds	\$0.02 per pound	10,839.36
744,270	Screw bolts and washers.....do	do	14,885.40
971	do.....do.....do	do	a 24.28
221,154	Lag screws and washers.....do	\$0.025 per pound	5,528.85
1,490	do.....do.....do	do	a 46.56
692,040	Drift bolts.....do	\$0.015 per pound	10,380.60
2,214	do.....do.....do	do	a 41.51
13,199	Spikes.....do	\$0.02 per pound	263.98
2,342	do.....do.....do	do	a 58.55
29,818	Straps.....do	\$0.03 per pound	894.54
266	do.....do.....do	do	a 9.96
127,528	Bent plates.....do	do	3,825.84
2,023	Wire nails.....do	\$0.02 per pound	40.46
109,367	Stone for filling cribs.....tons	\$0.80 per ton	87,493.78
23	do.....do.....do	do	a 23.00
125	Stone removed and replaced.....do	\$0.20 per ton	b 25.00
7,844	Stone for leveling foundation.....do	\$0.80 per ton	6,275.32
25,523	Stone for riprap protection.....do	do	20,418.96
38,462	Concrete blocks.....cubic feet	\$0.40 per cubic foot	15,384.89
4,694	Concrete in place.....cubic yards	\$5.00 per cubic yard	23,473.56
281,738	Dredging foundation.....do	\$0.08 per cubic yard	22,539.04
8,600	Sand filling.....do	\$0.20 per cubic yard	720.00
1,481	Removing old west pier.....linear feet	\$1.00 per linear foot	1,431.00
120	Logging.....hours	do	1,379.81
	Moving storehouse.....do	do	50.00
102,183	Hemlock timber.....feet B. M.	\$21 per 1,000 feet B. M.	2,144.79
6,403	White-pine timber.....do	\$36 per 1,000 feet B. M.	230.51
10,206	Tie-rods and washers.....pounds	\$0.0475 per pound	484.88
13,378	Screw bolts and washers.....do	do	685.46
15,563	Drift bolts.....do	do	789.24
	Total.....		419,161.70

a 25 per cent was added to the unit price of this material, as provided in paragraph 65 of specifications.

b In accordance with paragraph 65 of specifications.

**Dredging.**—In the last river and harbor bill it was provided that the Secretary of War might, in his discretion, dredge any part of the Cleveland Harbor to a depth of 25 feet.

Acting under this authority, and with the fact in view that the available depth in the entrance channel had decreased to such a degree as to render its use to some extent unsafe for heavily loaded vessels under some conditions of weather, it was recommended that the area between the Lake Shore Railway bridge and the main entrance be dredged to a depth of 25 feet. After the necessary regular proceedings, a contract, dated August 27, 1902, was entered into with the L. P. & J. A. Smith Company for excavating 200,000 cubic yards, more or less, at \$0.185 per cubic yard, making a total of \$37,000.

The contract stipulated that the dredging should be commenced within ten days after notification of approval of contract and be completed within four months thereafter. Owing to delay in the approval of the contract, work was not commenced

until October 24, and but 32,031 cubic yards had been excavated when winter set in, making further work at that time impracticable. Operations were not commenced this season until May 15, and but 50,961 cubic yards have since been excavated, making a total to date of 82,992 cubic yards, or less than one-half of the total necessary to complete the contract. Practically all of the dredging in the jettied channel has been completed, but there yet remains the area between the ends of the piers and the main entrance.

The following statement shows the character, quantity, and value of the work accomplished to June 30, 1903:

	Quantity.	Price per unit.	Value.
Dredging ..... cubic yards..	82,992	\$0.185	\$15,353.52
Logging ..... hours..	4½	30.61	130.09
Total .....			15,483.61

*East breakwater repairs.*—It has been recognized for some time that the timber superstructure of the west 2,494.5 feet of the east breakwater, constructed between 1888 and 1893, was deteriorating rapidly, and that unless repaired in season its entire removal would soon be a necessity.

Accordingly, under date of August 22, 1902, a project was submitted for repairing this work by filling up with small stone, renewing the decking, repairing the side walls, and protecting the exposed faces above water with 3-inch oak sheathing, and below water with 4-inch beech sheathing on the lake side and 3-inch beech sheathing on the harbor side, all to be done by hired labor and by the purchase of the necessary plant and materials in the open market, at an estimated cost of \$53,799.88. This project received the approval of the Chief of Engineers on September 5, and active operations were commenced as soon thereafter as the necessary materials could be assembled, and have since been continuously prosecuted.

A small deck barge, 18 by 30 by 4 feet, was constructed, at a cost of about \$700, and has been used with our gasoline launch for the transportation of all the construction materials and supplies. Two boring and bolting machines, similar to those used on the west breakwater, have been purchased, at a cost of \$1,600, for fastening on the under-water sheathing, but owing to unexpected delays in the delivery of these machines they are not yet in operation, although they are now being set up and will be ready for work in a short time.

The repairs of the deck and side walls have been practically completed and considerable sheathing has been fastened on both faces of the structure, although not yet finally bolted.

The following is a summary of the work accomplished and materials used:

Parapet deck repaired.....	linear feet..	2,250
Lower deck repaired .....	do.....	2,019
Spur deck repaired .....	do.....	118
Sheathing below water hung on harbor side .....	do.....	353
Sheathing above water completed on harbor side.....	do.....	202
Sheathing below water hung on lake side.....	do.....	198
Filling stone placed in superstructure.....	tons..	4,255.34
Yellow pine used for decking.....	feet B. M..	244,712
Hemlock used for side walls.....	do.....	59,575
Oak used for sheathing.....	do.....	12,429
Beech used for sheathing.....	do.....	8,078

The total amount expended, including the cost of plant and other materials on hand, is \$22,798.80.

*Improvement and enlargement of the harbor.*—The river and harbor bill approved June 13, 1902, appropriated \$2,800,000, to be expended under continuous contracts, for the improvement and enlargement of Cleveland Harbor by providing a safer and better entrance and by extending the breakwater eastward, all in accordance with the plans set forth in the report of Col. Jared A. Smith, Corps of Engineers, U. S. Army, dated August 17 and November 17, 1900, and printed as House Document No. 18, Fifty-sixth Congress, second session, except that it was provided that the center line of the new structure should be built upon the prolongation of the center line of the main portion of the existing breakwater, and that there should be no further extension of the deflected portion of the east breakwater, then under contract.

As soon as the provisions of the bill became known complete plans and specifications were prepared in anticipation of its passage, so that the work provided for

## 2080 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

could be placed under contract with the least possible delay. In order to invite the widest competition the work was divided into three contracts, one covering the improvement and enlargement of the main entrance and the other two the construction of the east breakwater extension in about two equal divisions. Proposals were requested for the use of both stone and timber cribs with concrete superstructure for the breakwaters. Bids were opened on August 28, 1902, but the figures were thought to be too high and the work was re-advertised.

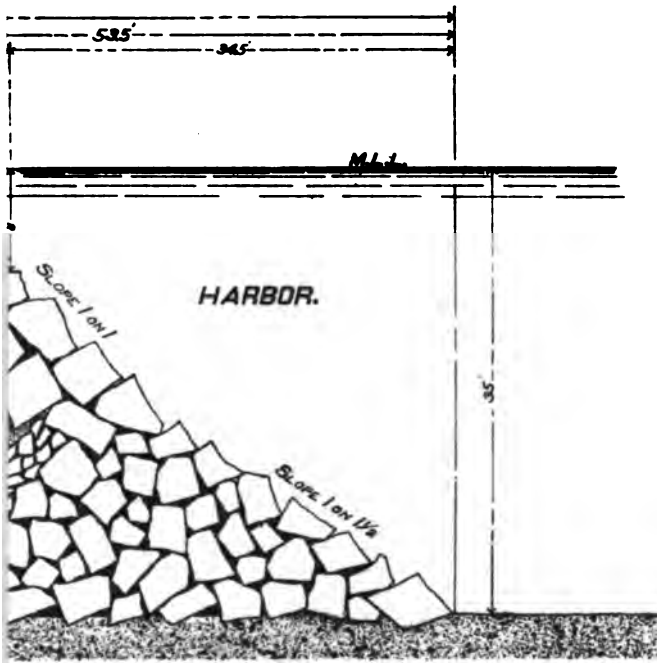
Under the second plans and specifications the requirements for the paving and riprap stone and the conditions for acceptance of the work were somewhat modified, the timber crib and concrete breakwaters were omitted, and bids were asked for two types of rubble-mound breakwaters. In type A the interior mass or core which comprises 45 per cent of the whole area of the cross section, was all to be of small stone, furnace slag, shale, or coarse gravel while in type B the core filling, below a depth of 20 feet, or about two-thirds of the whole core was to be made of lake sand.

The proposals, which were opened on November 6 showed a total saving over the previous letting of \$356,702 for type A and of \$508,092 for type B which was adopted for the breakwater work.

*Main entrance.*—A contract dated November 19 1902, was entered into with the L. P. & J. A. Smith Company of Cleveland, Ohio, the lowest bidder, for the improvement and enlargement of the main entrance. This contract comprises the construction of rubble-mound breakwaters 1,250 feet long, on each side of the present main entrance. These breakwaters converge at an angle of 53° with the face of the existing breakwater, and terminate in pierheads 700 feet apart, 1,000 feet outside of the present entrance. The lake face of the existing breakwater for 1,000 feet beyond the junction with the new breakwaters is to be suitably protected with riprap and paving stone, and the west 200 feet of the present east breakwater is to be removed to a depth of fully 25 feet below mean lake level.

The total estimated cost of executing this contract and the nature and quantity of the necessary materials is as follows:

Material, etc.	Quantity.	Rate.	Amount.
<i>Two pierheads.</i>			
Hemlock timber ..... feet B. M.	440,000	\$26.75	\$11,770.00
Beech or other acceptable hardwood timber ..... do.	40,000	40.00	1,600.00
Large riprap stone for foundation and protection ..... tons.	8,000	1.50	12,000.00
Small riprap stone for foundation and crib filling ..... do.	18,000	1.24	22,320.00
Small paving stone for well ..... do.	500	3.50	1,750.00
Bolts, tie rods, etc. .... pounds.	200,000	.04	8,000.00
Concrete blocks and steps ..... cubic yards.	650	10.00	6,500.00
Concrete in mass ..... do.	1,050	9.00	9,450.00
Wrought-iron pipe and fittings ..... pounds.	2,000	.40	800.00
<b>Total</b> .....			<b>73,190.00</b>
<i>Two rubble mound breakwaters, type B.</i>			
Large riprap stone ..... tons.	60,000	1.50	90,000.00
Heavy riprap stone ..... do.	36,000	1.55	55,800.00
Small riprap stone ..... do.	96,000	1.30	123,500.00
Large paving stone (first class) ..... do.	39,000	2.30	90,000.00
Large paving stone (second class) ..... do.	12,500	2.90	36,250.00
Core filling, coarse gravel, furnace slag, etc. .... cubic yards.	60,000	.70	42,000.00
Core filling, lake sand ..... do.	75,000	.40	30,000.00
<b>Total</b> .....			<b>460,550.00</b>
<i>Riprap protection for present breakwaters.</i>			
Large riprap stone for foundation and protection ..... tons.	4,000	1.50	6,000.00
Small riprap stone for foundation and filling ..... do.	18,000	1.30	23,400.00
Large paving stone (second class) ..... do.	13,500	2.90	39,150.00
Core filling, coarse gravel, furnace slag, etc. .... cubic yards.	40,000	.70	28,000.00
<b>Total</b> .....			<b>96,550.00</b>
<i>Removing and repairing end of east breakwater.</i>			
Removing old breakwater protection and underlying material ..... cubic yards.	9,500	.50	4,750.00
Hemlock timber ..... feet B. M.	2,000	40.00	80.00
Oak timber ..... do.	7,000	100.00	700.00
Large riprap protection ..... tons.	400	1.50	600.00
Bolts, tie rods, etc. .... pounds.	1,000	.06	60.00
<b>Total</b> .....			<b>6,190.00</b>
<b>Total cost</b> .....			<b>636,480.00</b>



**CLEVELAND HARBOR, OHIO. ———**  
**——— BREAKWATER. ———**  
**——— TYPE "B" ———**

*U.S. Engineer Office.  
 Cleveland, Ohio, Oct. 6, 1902.*

*Harvey G. Ingman*  
 Major, Corps of Engineers, U. S. Army.

*A. H. 1000*





Under the agreement with the L. P. & J. A. Smith Company they are required to earn \$150,000, less the cost of supervision and inspection, before December 31, 1903, and at the same rate annually thereafter if funds are provided. Work was commenced on April 20, but owing to the inadequacy of the plant furnished and the necessity for extensive repairs they have not even approximated the rate necessary to comply with the contract requirements.

The following statement shows the character, quantity, and value of the work accomplished to June 30, 1903:

Material.	Quantity	Price per unit.	Value.
Large riprap stone in west breakwater.....tons..	4,591.4	\$1.50	\$6,887.10
Small riprap stone in west breakwater.....do..	870	1.80	741.00
<b>Total</b> .....			<b>7,628.10</b>

*East breakwater extension.*—Hughes Brothers & Bangs, of Syracuse, N. Y., were the successful bidders for both divisions of the east breakwater extension, and on November 20, 1902, contracts were entered into with them for the work.

These contracts comprise two divisions of about equal extent and cost. The western division will begin with a pierhead 60 by 60 feet 200 feet west of the end of the shore arm of the present east breakwater, with its center line in the prolongation of the center line of the present structure and will extend eastward in the prolongation of said east breakwater about 5,000 feet. The eastern division will begin where the western division ends and extend eastward on same line 5,000 feet, more or less, depending on the funds available under the present act of Congress, after paying for the cost of supervision, inspection, and contingencies.

The total estimated cost of executing these contracts and the nature and quantity of the necessary materials is as follows:

Material.	Quantity.	Rate.	Amount.
<b>WESTERN DIVISION.</b>			
<i>One pierhead.</i>			
Hemlock timber .....	175,000	\$28.00	\$4,900.00
Oak timber .....	18,000	50.00	900.00
Large riprap stone for foundation and protection.....tons..	3,000	1.80	3,900.00
Small riprap stone for foundation and crib filling.....do..	6,500	1.14	7,410.00
Small paving stone for well .....	250	4.00	1,000.00
Bolts, tie rods, etc. ....	70,000	.04	2,800.00
Concrete blocks and steps.....cubic yards..	250	11.00	2,750.00
Concrete in mass .....	500	8.00	4,000.00
Wrought-iron pipe and fittings.....pounds..	1,000	.60	500.00
<b>Total</b> .....			<b>28,160.00</b>
<i>Rubble mound breakwater, type B.</i>			
Heavy riprap stone.....tons..	70,000	1.35	94,500.00
Large riprap stone .....	200,000	1.30	260,000.00
Small riprap stone .....	190,000	1.14	216,600.00
Large paving stone (first class).....do..	60,000	2.75	165,000.00
Large paving stone (second class).....do..	25,000	2.70	67,500.00
Core filling, coarse gravel, furnace slag, etc.....cu. yds..	100,000	.70	70,000.00
Core filling, lake sand .....	200,000	.40	80,000.00
<b>Total</b> .....			<b>968,600.00</b>
<b>EASTERN DIVISION.</b>			
<i>Rubble mound breakwater, type B.</i>			
Heavy riprap stone.....tons..	70,000	1.35	94,500.00
Large riprap stone .....	200,000	1.30	260,000.00
Small riprap stone .....	190,000	1.14	216,600.00
Large paving stone (first class).....do..	60,000	2.75	165,000.00
Large paving stone (second class).....do..	24,000	2.70	64,800.00
Core filling, coarse gravel, furnace slag, etc.....cu. yds..	100,000	.70	70,000.00
Core filling, lake sand .....	237,500	.40	95,000.00
<b>Total</b> .....			<b>965,900.00</b>
<b>Total cost</b> .....			<b>1,947,660.00</b>

## 2082 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

Under the agreement these contractors are required to earn \$175,000, less the cost of supervision and inspection, on each division before December 31, 1903, and at the same rate for each division annually thereafter if funds are provided. On May 25 the contractors made written application to have their contracts so modified as to allow them to concentrate their energies on the construction of the western division and complete the work continuously from the western end instead of in two divisions as required by the contracts. They represented that this privilege would enable them to concentrate their forces and plant and would result in expediting the completion of the whole work.

The modification asked for was considered to be advantageous to all concerned. to the contractors for the reasons stated and because less incomplete and unprotected work would be subject to the action of storms; to the United States because the work could thus be completed at less risk of damage and at considerably less cost for inspection and supervision; and to the shipping interests because adequate protection would sooner be afforded, and enable the extension of the harbor facilities along the lake front. Therefore, by authority of the Chief of Engineers, the privilege asked for was granted by you on June 19, 1903, with the distinct understanding that the rate of progress should at least equal that required by the contracts for both divisions, and that if the progress was not satisfactory the work should, if required, be prosecuted on both divisions as originally intended.

The contractors have opened extensive quarries on Johnsons Island, in Sandusky Bay, and have brought here a large and adequate plant for the execution of the work, but as yet have not succeeded in making the progress necessary to comply with the contract requirements. Actual operations were commenced at Cleveland on May 4, by driving the guide and line piles for the first section of the western division. The first barge load of stone was delivered on May 6 and deposited in the inside foundation ridge.

The following statement shows the nature, quantity, and value of the materials furnished to June 30, 1903:

Material.	Quantity.	Price per unit.	Value.
Large riprap stone, in breakwater.....tons..	17,611.8	\$1.30	\$22,896.34
Small riprap stone, in breakwater .....do.....	2,262.36	1.10	2,488.59
Core filling, lake sand .....cubic yards..	567.6	.40	227.04
Total .....			25,701.47

In order to assist in the proper inspection and supervision of these contracts a sounding barge, 120 feet long, 24 feet wide, and 5 feet deep, with suitable accommodations for the inspectors, and a steam tug 65 by 15 by 8 feet have been constructed. The sounding barge cost about \$4,100. It was constructed last winter at Sandusky, Ohio, by hired labor. The tug cost \$6,900 for the bare hull and machinery; it was built this spring at Ashtabula, Ohio, by contract with J. G. Laird & Sons, for the hull, and with W. S. McKinnon for the machinery; it is now being painted and fitted out, and will soon be in commission.

The driving of the necessary guide and line piles for the first 1,000-foot section of the east breakwater extension has fully developed the fact that the lake bottom over this area at least is quite soft for a depth of from 7 to 10 feet. The piles used settled this amount under the weight of a 5,000-pound steam hammer alone. Below this depth the bottom is much harder and the average penetration under a full blow of this hammer ranged from 0.2 to 0.7 feet. Although no particular settlement of the stone already placed in the structure is yet noticeable, it is reasonable to suppose that a considerable settlement will eventually take place. An allowance of 10 per cent was made in the estimated quantities in the work to cover this contingency.

*Injuries and repairs to existing works.*—The tug *Alva B.*, owned by The Great Lakes Towing Company, on July 10, 1902, ran into the fender of the west pier, about 20 feet north of the United States storehouse, breaking off one pile and more or less damaging 18 linear feet of the fender. The cost of repairing this damage, which was estimated at \$77.44, was paid by the owners of the boat. The damage done to the end of the west pier by the steamer *Crescent City* on November 25, 1901, has been fully repaired and the cost (\$200) paid by the owner of the vessel.

The concrete superstructure of the west breakwater has been more or less disfigured by settlement and movement of adjacent blocks of concrete, and the oak fenders along the harbor face of this structure are beginning to check and show the effect of exposure to the weather; it is suggested that the necessary repairs to the concrete superstructure, and that the painting of the oak fenders be undertaken by hired labor at an early date.

**Dump grounds.**—The area in which materials may be deposited in the lake, under proper restrictions, comprises between 400 and 500 acres, lying between temporary waterworks cribs Nos. 1 and 2. The immediate vicinity in which dumping should be done is indicated by a buoy, which is moved from time to time, in order to prevent decreasing the depth to less than 35 feet. One case of illegal dumping of ashes in the jettied channel has been reported during the year. This case is now in the hands of the United States district attorney for prosecution.

**Lake levels.**—The highest, lowest, and mean elevation of the water surfaces at the Cleveland gauge for each month in the year, with reference to the mean lake level for 1860 to 1875, are given in the following table:

	Highest elevation.	Lowest elevation.	Mean elevation.
1902.			
July .....	+0.39	−0.50	−0.026
August .....	+ .37	− .40	− .046
September .....	+ .08	− .75	− .393
October .....	+ .30	−1.30	− .480
November .....	− .30	−1.60	− .753
December .....	−1.10	−1.66	− .940
1903.			
January .....	− .78	−1.85	−1.056
February .....	− .58	−2.16	−1.060
March .....	+ .02	−1.02	− .490
April .....	+1.00	− .39	+ .292
May .....	+ .66	+ .11	+ .316
June .....	+ .55	+ .09	+ .279
For fiscal year 1903 .....	+1.00	−2.16	− .863

The plane of reference for the Cleveland gauge is the high water of 1834, 575.20 feet above mean tide at New York. The zero of the gauge is set at the mean level for 1860 to 1875, 2.34 feet below the plane of reference and 572.86 feet above mean tide at New York.

**Work done by the city.**—The city of Cleveland, through its department of harbors and docks, has in charge the improvement and maintenance of the channel in the Cuyahoga and Old rivers. They have under construction extensive docks and wharves along the lake front between Erie and Seneca streets. The work now underway by the city at Jefferson street will straighten out one of the worst bends in the river and open up for large vessels a long stretch of dockage not heretofore available.

The following summary shows the work done by the city during the past year:

Straightening the Cuyahoga River at Jefferson street .....	\$32, 730
Lake front improvement at Erie street .....	28, 600
Dredging river channel, 161, 860 cubic yards .....	25, 088
Total .....	86, 418

**Surveys.**—A careful survey is in progress of all the area covered and protected by the east breakwater extension. As accurate soundings can only be made when the water is calm, the progress is necessarily slow and the work comparatively expensive. An effort was made to complete these surveys on the ice last winter, but it was found unsafe to work out as far from the shore as necessary to cover the desired territory. Observations have been kept up during the year to determine the run-off and quantity of sediment carried into the lake by the Cuyahoga River, and have been made the subject of a special report. These observations indicate that about 200,000 cubic yards of sediment pass the Lake Shore Railway Bridge annually. Judging from the comparative figures given in my last annual report, it appears probable that fully 50 per cent of this amount finds lodgment in the channel and protected area.

Careful levels have been recently run over all of the structures in Cleveland Harbor in order to determine their settlement or change in position since erection. These levels show an average and quite uniform settlement since June, 1902, of 0.08 feet for the reconstructed part of the west breakwater, and of 0.2 feet for the timber extension of the east breakwater. No change in the elevation of the east and west pier was noticeable.

The work in Cleveland Harbor has been executed under the local supervision of Mr. L. C. Schnell, junior engineer.

Very respectfully,

Maj. DAN C. KINGMAN,  
Corps of Engineers.

G. T. NELLIS,  
United States Assistant Engineer.

## R R 8.

## IMPROVEMENT OF FAIRPORT HARBOR, OHIO.

For a description of the location, projects of improvement, and the general conditions at this harbor, see pages 2676 and 2677, Report of Chief of Engineers, 1898.

The harbor of Fairport is situated at the mouth of Grand River, a stream of considerable size and having a drainage basin of 759 square miles in area. Like all of the harbors at the mouths of creeks or rivers on Lake Erie, the improvement was first effected by the construction of parallel jetties extending outward into the lake. The distance between these jetties was necessarily small, those at Fairport being about 200 feet apart. It is very difficult for a ship four or five hundred feet in length to enter such a narrow opening, particularly under the disturbing influence of wind, waves, and shore currents, without striking one of the jetties. This has happened so frequently at the different harbors that there can be no question of the fact that it is unavoidable. Such a collision can not take place without injury to something. As the jetties are now constructed of timber cribs filled with small stone they receive the entire injury and the vessel escapes unharmed. The alternative would be to make the jetties so strong that the vessel would receive the entire injury. Neither of these solutions would be satisfactory, for it is as undesirable to destroy the vessels seeking a harbor as it is to have them destroy the works necessary to maintain it.

To meet this condition a number of years ago a plan was devised for constructing two detached breakwaters at this and a number of other jettied harbors, converging toward the lake and having an opening between their outer extremities, two or three times as great as the opening between the jetties, the gorge line of the breakwater being situated at about the outer end of the jetties. The entrance was placed on the prolongation of the axis of the channel and from 1,000 feet to 1,500 feet from the outer end of the jetties. This afforded a very much wider and safer entrance to the vessels and permitted them to enter, if necessary, at an angle and gave them space enough to straighten up before entering the narrow channel; and because the breakwaters diverge toward the shore they give the waves coming through the entrance an opportunity to spread and to die down so as to leave an area of smooth water near the entrance to the jetties.

It was hoped when the work was planned that these breakwaters, inclined as they were to the shore line, would produce an effect upon the direction of the waves and shore currents that would diminish, if not entirely do away with, the formation of bars across the channel. Unfortunately the portion of breakwater already built at Fairport does not seem to indicate that this will be the result. On the contrary, observations demonstrate the fact that the bar formation is more rapid and more objectionable than before the present section of breakwater was constructed. This leads to a consideration of the source of bar-making material and the manner in which bars are formed at the entrance of the jettied harbors on the lakes.

As explained elsewhere in this report, the Grand River annually transports to Lake Erie not less than 157,000 cubic yards of silt, but almost all of this material is brought down during periods of freshets, which are of short duration. The observations showed that nearly

one-sixth of the entire deposit of the year came out of the channel in a single day. In the time of freshets a very considerable volume of water is discharged by the river and the current is strong and its course can be marked by the discoloration for a long distance out into the lake, the direction of flow varying with the direction and intensity of the shore currents. Therefore the river silt must be distributed over a very wide area of the lake bottom, and while it must cause a gradual shoaling it probably does not form a very direct or important element in the annual bar formation at this place. The source of the trouble must be looked for elsewhere, and it is undoubtedly due to the movement of the beach sand under the combined action of waves and currents.

The existence of a sandy beach implies the existence not far away of a source of supply of beach-forming material. This is usually a high-bluff bank or headland that is being gradually undermined and washed away by the action of the waves and currents, the material of which is assorted and transported by the water so as to form the beach in the first place and to maintain it and perhaps augment it thereafter. The beach sand is moved in two different ways; first, by the direct action of the waves breaking upon the shore, and second by the action of the littoral currents.

When a wave advances into shoal water so as to feel the retarding effect of the bottom the axis of oscillation of the particles of water ceases to be vertical and becomes inclined toward the shore, the shoreward face of the wave becomes steeper and it finally breaks, and the water flows rapidly up the beach and immediately flows back. The motion of translation of the water as the depth diminishes becomes sufficiently great to sweep the sand along the bottom, to carry it up the incline, and as the wave returns to carry it, or the greater part of it, back again. If the crest of the wave is inclined to the shore line the sand is pushed up the beach obliquely, and as the reflow is nearly normal to the shore line the sand is advanced by each successive wave in the direction along the shore in which the waves are running. Another storm in the opposite direction may move it back again, but if, as is usually the case, the prevailing storms are from one direction the resultant movement of the sand will conform.

Upon Lake Erie, the prevailing storms are from the westward, and as a result there is a constant movement of sand toward the east. If this movement is arrested by a wharf, jetty, or other structure extending outward from the shore, the sand will gather against it and the shore line will advance accordingly.

The second mode of sand movement results from the action of the shore currents. These currents on the lakes are not sufficient of themselves to pick up the material from the bottom and move it along; but in the time of storms, when the waves are breaking upon the shore, they stir up the sand at the source of supply as well as upon the beach itself, lift it up and hold it in suspension for a time, the finest and lightest particles being held the longest. If, at this time, there happens to be a current along the shore, or outward toward deeper water in the lake, the material so suspended will move with the current until it gradually sinks and comes to rest upon the bottom. This action will make itself felt in much deeper water than that of the waves alone.

On Lake Erie the direct action of the waves produces little or no motion of sand in a greater depth of water than 12 or 15 feet, but the currents may carry suspended material into any depth depending upon

their velocity and direction and the length of time that the silt can be floated.

At the harbor of Fairport, the sand movement and the resulting bar formation is more marked and extensive than at any other harbor in the Cleveland district. For this reason it is a particularly favorable place for the study of this action. The earlier maps are not extensive enough or in sufficient detail to furnish data for a satisfactory comparison, but such a comparison as it has been possible to make indicates that not less than 500,000 cubic yards of sand has accumulated in the last forty-eight years in an area bounded by the original shore line, the west jetty, the 20-foot contour in the lake, and a straight line parallel to the jetty and 1,000 feet west of it. One thousand feet from the jetty was as far as it was possible to extend the comparison on account of the limited area covered by the old map, but the actual amount of sand arrested by the jetty must be three or four times as great as this. This represents the net result of sand movement in this area, but it by no means represents the aggregate movement. The conditions are such as to cause any excavation or artificial deepening to be very quickly filled. A single storm in November, 1901, caused a fill of not less than 20,000 cubic yards to take place in an area 500 feet by 250 feet in the channel immediately beyond the outer end of the jetties.

A number of observations have been made at Fairport to determine the velocity and direction of the shore currents and the amount of sediment carried in suspension. The prevailing direction of the currents was found to be from west to east, generally parallel to the shore, but moving outward to pass around the end of the jetties or around the ends of the detached piece of breakwater.

In making these observations long weighted rods were used, about nineteen-twentieths of their length being submerged, so that the wind could have very little effect upon them. At the same time observations were taken to determine the amount of sediment in suspension in the water. Samples of water were taken at a number of different buoys properly located in the direction of the currents. These samples were taken about 2 or 3 feet above the bottom, and the amount of sediment was afterwards determined by filtering and weighing. The results showed that the currents might be as great as a mile an hour and that the sediment in suspension always diminished as the currents moved outward from the shore. The loss of suspended sediment was sufficient to account for a fill across the channel beyond the end of the jetties as great as four-tenths of a foot in twenty-four hours during a storm of very moderate violence.

These observations were not taken under conditions to give maximum results. A rowboat was necessarily used for placing and picking up the buoys and for securing samples of water. It was not possible to send it out in a time of a very severe storm. If it had been possible, no doubt greater currents would have been observed and a very much larger amount of sediment would have been found in suspension and its effect would have extended very much farther outward into the lake.

There has already been constructed at Fairport a length of 828 feet at the shoreward end of the west breakwater. The current flows around the shoreward end of this structure and then across the channel beyond the outer end of the jetties. It also flows around the outer end of the structure and across the channel, thus developing a tendency to

form two bars across the track of vessels approaching the harbor. There is also an extensive fill in the comparatively still water to the eastward of this structure. Since it has been built there has been a fill of 8 or 10 feet on a line drawn from the outer end of the west jetty perpendicular to the breakwater.

It seems certain to me if the plan is carried out in its entirety that the area sheltered by the jettied breakwaters will be a place where very rapid deposit of sand will take place and an enormous amount of dredging will be necessary to maintain even a navigable channel outward to the lake. Since 1895 it has been necessary to dredge more than 187,000 cubic yards of material to maintain a narrow channel from the outer end of the jetties to deep water in the lake. The area on each side of the channel is rapidly filling up, thus making the cut to be maintained relatively deeper and more sharply defined and increasing the rate of deposit that will take place in it.

I am of the opinion that it would be desirable, and that it is even necessary, to somewhat modify the original plan, first, by extending the west breakwater so as to connect with the shore, and thus cutting off the current and the sand supply from the beach. This shore connection could well be made parallel to the jetties, and would be 825 feet from them. The outward extension of the breakwater might also be given the same direction, so as to hold its outer end farther away from the channel. This would make it about 472 feet distant from the line of the west jetty prolonged. The completed structure would serve not only as a breakwater to shelter the entrance to the jetties from storms coming from the west, but it would also serve the purpose of a groin to arrest the movement of sand along the beach. The bar that would ultimately lap around the end would have to extend 500 feet before interfering with the channel. I would recommend that the structure be of the rubble mound type, and in the interests of economy I would not pave the slopes, but would construct the upper portion of it of very large blocks of stone of not less than 10 or 12 tons in weight, deposited so as to secure the general form desired, but with no attempt to lay them in the form of a pavement. The outer end should be terminated as proposed in a pierhead suitable for supporting a light-house. If this were done the construction of the east breakwater might be postponed for a time and it might be found, since the prevailing storms come from the west, that it would not be necessary at all.

The estimated cost of completing the project as it now stands is \$480,000. The completion of the modified west breakwater would cost \$273,000, and this expenditure, I think, might now be safely and advantageously made.

The river and harbor act of June 13, 1902, appropriated \$200,000 for continuing the improvement at Fairport and for maintenance. Twenty-five thousand dollars of this amount was allotted toward the construction of a seagoing hydraulic dredge. The greater part of the remainder is being applied to the repair and reconstruction of the shore ends of the jetties. These were in a ruinous condition and liable to be breached. Their preservation is absolutely necessary to the preservation of the harbor. The work was duly placed under contract and satisfactory progress is now being made. It is probable that the proposed improvement will be completed by the end of the present working season.

## 2088 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

For a detailed description of the work actually accomplished, and what is still proposed under the contract, attention is respectfully invited to the report of Assistant Engineer G. T. Nelles, which is transmitted herewith.

\* \* \* \* \*

*Money statement.*

July 1, 1902, balance unexpended .....	\$200, 120. 07
June 30, 1903, amount expended during fiscal year .....	31, 896. 85
July 1, 1903, balance unexpended .....	168, 223. 22
July 1, 1903, outstanding liabilities .....	3, 579. 36
July 1, 1903, balance available .....	164, 643. 86
July 1, 1903, amount covered by uncompleted contracts .....	110, 005. 49
(Amount (estimated) required for completion of existing project .....	480, 000. 00
Amount that can be profitably expended in fiscal year ending June 30, 1905, in addition to the balance unexpended July 1, 1903:	
For works of improvement .....	\$273, 000. 00
For maintenance of improvement .....	20, 000. 00
	293, 000. 00
Submitted in compliance with requirements of sundry civil act of June 4, 1897, and of section 7 of the river and harbor act of 1899.	

AMOUNT AND DATE OF ALL APPROPRIATIONS.

March 3, 1825 .....	\$1, 000. 00	March 3, 1881 .....	\$10, 000. 00
May 20, 1826 .....	5, 620. 00	August 2, 1882 .....	10, 000. 00
May 19, 1828 .....	9, 135. 11	July 5, 1884 .....	10, 000. 00
April 23, 1830 .....	5, 563. 18	August 5, 1886 .....	18, 750. 00
March 2, 1831 .....	5, 680. 00	August 11, 1888 .....	10, 000. 00
July 3, 1832 .....	2, 600. 00	September 19, 1890 .....	20, 000. 00
June 28, 1834 .....	10, 000. 00	July 13, 1892 .....	35, 000. 00
July 2, 1836 .....	6, 000. 00	August 18, 1894 .....	20, 000. 00
July 7, 1838 .....	10, 000. 00	June 3, 1896 .....	30, 000. 00
June 11, 1844 .....	10, 000. 00	March 3, 1899 .....	100, 000. 00
August 13, 1852 .....	10, 000. 00	July 31, 1900 (allotment) .....	3, 000. 00
June 28, 1864 .....	24, 435. 24	April 15, 1902 (allotment) .....	1, 800. 00
June 23, 1866 .....	24, 072. 00	June 13, 1902 .....	200, 000. 00
March 2, 1867 .....	60, 000. 00		
June 23, 1874 .....	20, 000. 00	Total .....	700, 655. 53
March 3, 1875 .....	15, 000. 00	Expended to June 30, 1903 .....	532, 432. 31
August 14, 1876 .....	5, 000. 00		
June 18, 1878 .....	5, 000. 00	Unexpended July 1, 1903 .....	168, 223. 22
June 14, 1880 .....	3, 000. 00		

LIST OF CONTRACTS IN FORCE DURING THE FISCAL YEAR ENDING JUNE 30, 1903.

*Contract for reconstructing and repairing parts of east and west piers.*

Name of contractor: The Donnelly Contracting Company, Buffalo, N. Y.  
Date of contract: September 29, 1902.  
Date of approval: October 30, 1902.  
Date of commencement: November 3, 1902.  
Date of completion: December 1, 1904.



## COMMERCIAL STATISTICS.

The following statistics for the year 1902 relative to the commerce of the harbor Fairport, Ohio, were compiled from information furnished by the collector of customs and by the owners of vessels that visited the port:

Receipts.	Tons.	Shipments.	Tons.
Fish .....	398	Coal and coke.....	266,843
Flour .....	119,949	Flour.....	175
Grain and produce.....	20,563	Merchandise .....	34,474
Iron ore.....	1,723,398	Stone.....	2,288
Lumber, logs, etc.....	14,000	Miscellaneous.....	1,780
Merchandise.....	145,096		
Shingles.....	1,245		
Miscellaneous.....	282		
Total.....	2,024,920	Total.....	305,560

Total freight tonnage:	
1902.....	2,830,490
1901.....	1,639,764
Increase.....	690,716

Vessels.	Number.	Tonnage.
Entering.....	454	964,552
Departing.....	435	939,259

Total registered tonnage:	
1902.....	1,908,811
1901.....	1,485,441
Increase.....	413,370

Draft of largest vessels using harbor, 20 feet.  
 Largest vessels do not load to full depth.  
 No new vessel lines established during the year.

## REPORT OF MR. G. T. NELLER, ASSISTANT ENGINEER.

CLEVELAND, OHIO, *June 30, 1903.*

MAJOR: I have the honor to submit the following report of operations, carried on under my local supervision, at Fairport Harbor, Ohio, during the fiscal year ending June 30, 1903:

As soon as the provisions of the last river and harbor bill concerning this harbor became known a project was prepared, with complete plans and specifications for the expenditure of the amount to be appropriated, so that the work might be placed under contract at the earliest practicable time after the actual passage of the bill. After the necessary regular proceedings, bids were opened on August 18, 1902. All of these bids were considered excessive, the lowest exceeding our estimate by 33½ per cent, consequently they were rejected and the work was readvertised, under slightly modified specifications. The second set of bids was opened September 18, and the contract awarded to the Donnelly Contracting Company, of Buffalo, N. Y., by an agreement dated September 29, 1902.

The work to be done under this contract comprises the entire removal of the inner 595 feet of the east pier and its reconstruction of stone-filled timber cribwork, with concrete superstructure; the strengthening and repairing of the inner 575 feet of the west pier by means of piling and a concrete and stone superstructure, and the sheathing with 3-inch oak plank of both sides and the outer ends of the substructure, and repairing the superstructure of the outer 520 feet of the east and 617 feet of the west pier.

# 2090 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

The total estimated cost of executing this contract and the nature and quantity of the necessary materials is as follows:

	Quantities.	Rate.	Amount.
<i>East pier reconstruction.</i>			
Removal of old pier.....cubic yards..	7,500	\$0.50	\$3,750.00
Dredging.....do.	15,000	.25	3,750.00
Hemlock timber.....feet B. M..	640,000	28.50	18,240.00
Old timber decking, etc.....do.	22,000	22.50	495.00
Beech or other acceptable hard-wood timber.....do.	65,000	36.00	2,340.00
Bolts, tie-rods, etc.....pounds..	180,000	.04	7,200.00
Concrete blocks.....cubic yards..	710	11.37	8,072.70
Concrete in mass.....do.	2,100	7.50	15,750.00
Small riprap stone for filling cribs and foundation.....tons..	10,500	1.33	13,965.00
<i>West pier reconstruction.</i>			
Removal of old pier.....cubic yards..	3,500	1.00	3,500.00
Other excavations.....do.	1,800	.25	450.00
Sheet piling complete in place.....feet B. M..	170,000	50.00	8,500.00
Old timber decking and foundations.....do.	25,000	27.50	687.50
Beech or other acceptable hard-wood timber.....do.	7,000	46.00	322.00
Hard-wood piles in place.....linear feet.	17,500	.35	6,125.00
Pile rings and shoes left in work.....pounds..	10,000	.075	750.00
Bolts, tie-rods, etc.....do.	50,000	.04	2,000.00
Refilling pier and back filling with stone taken from old cribs, cubic yards.....	2,000	1.31	2,620.00
Back filling with sand.....cubic yards..	1,500	.44	660.00
Concrete blocks.....do.	575	11.25	6,468.75
Concrete in mass.....do.	1,200	7.50	9,000.00
Sawed sandstone flagging, 6 inches thick.....square feet..	8,800	.44	1,672.00
<i>Sheathing and repairing old piers.</i>			
8-inch beech or other acceptable hard-wood plank.....feet B. M..	85,000	123.00	10,455.00
Lag screws and washers.....pounds..	30,000	.04	1,200.00
Pine plank.....feet B. M..	85,000	44.00	3,740.00
Pine stringers.....do.	12,000	44.00	528.00
Hemlock timber.....do.	30,000	29.00	870.00
Bolts and spikes.....pounds..	20,000	.04	800.00
Total.....			133,910.95

The following considerations led to the selection of the form of construction adopted for west pier repairs: On this side the sand has filled up to the level of the top of that portion of the pier requiring renewal for nearly two-thirds of its length, and is above mean lake level for the remainder of this section. By reason of this condition the pier is entirely protected from the action of ice and heavy seas, and is only necessary as a revetment to outline the channel and prevent the banks from sliding into it, therefore the expense of entirely removing the old pier and replacing it with a new one, as proposed for the east pier, did not appear to be necessary. From a very careful examination of the old pier and the requirements of the location, a design was prepared which utilized the old work, and which it is believed will prove a permanent and satisfactory improvement, at a much less cost than if the old pier was removed and entirely rebuilt.

The plan adopted and being carried out consists of driving a row of 12-inch tongued-and-grooved sheet piling along the face of the present structure and four rows of round hard-wood piles inside of the old cribs. These piles form the foundation of the concrete superstructure, the face or channel half of which is similar in section to that proposed for the east pier, while the back half is composed of a light concrete wall resting on the back row of piles and the back edge of the old cribs. The space between this wall and the face wall is to be filled up with small riprap stone and covered with a 6-inch flagstone, at same level as the concrete top of the face wall. The cost of this style of construction will be about \$75 per linear foot, whereas if crib construction similar to the east pier had been used the cost would have been \$125 per linear foot.

Actual construction operations were begun on the west pier on November 3, 1902, and were carried on throughout the winter, but owing to the inadequacy of the plant originally furnished the progress has been very unsatisfactory, and only a small part of this particular work has been completed. The contractors at first attempted to drive piles with an ordinary drop hammer, but a 5,000-pound steam hammer was soon substituted, and with this no particular difficulty was experienced in driving the round hard-wood piles through from 8 to 10 feet of small riprap filling stone and from 10 to 20 feet of sand, thus securing a total penetration of from 18 to 30 feet.

Great difficulty, however, was experienced on the start in driving sheet piling to proper line and position, but after repeated trials and additions to plant and change in method the contractors finally perfected an arrangement whereby they were able to drive from 12 to 16 sheet piles (12 by 16 inches by 24 feet) per day. The presence of a thick strata of clay made it very difficult to place the sheathing with an ordinary jet, but by using a patent jet with turbine cutter head in connection with their steam hammer very successful and satisfactory work was accomplished. Crib construction for the east pier was commenced on May 10, and two substructure cribs, containing 460,000 feet B. M. of beech and hemlock timber, have since been completed. Much better progress would have been made but for delays caused by difficulty in obtaining proper timber.

The contractors' plant and appliances for crib work are very complete, and consist of a planer, an air-compressor plant capable of running 8 or 10 boring machines, a derrick and derrick boat for handling and setting timbers, and launching ways for building two 32-foot grillages at one time. With ample materials at hand this plant should have a capacity of 20,000 feet B. M. per day. The plant was made much more complete than the Fairport work alone justified, because it is the intention of the contractors to make use of it for the construction of cribs for the work at Conneaut, for which they also have the contract. All necessary preparations have been made for making concrete, and it is expected to begin this work early in July.

The following work has been accomplished during the fiscal year: The superstructure of the west pier has been removed, and all of the round foundation piles and two-thirds of the sheet piles have been driven; on the east side the old pier has been removed, one substructure crib, 20 feet by 192 feet, sunk in position, and a second crib of same dimensions practically ready for sinking. The sheathing has been hung for a considerable length on the outer end of the west pier, but only 150 linear feet has been finally secured in place by bolting.

The character, quantity, and value of the labor and materials furnished during the fiscal year, for which payment has been made, is as follows:

	Quantity.	Rate.	Amount.
<i>West pier reconstruction.</i>			
Old pier removed .....	cubic yards.. 1,015.6	\$1.00	\$1,015.60
Other excavations .....	do. 1,513	.25	378.50
Hard-wood piles in place .....	linear feet.. 18,000	.35	6,300.00
Pile shoes left in work .....	pounds.. 783	.075	58.73
Sheet piling, complete in place .....	feet B. M.. 81,860	50.00	4,068.00
<i>East pier reconstruction.</i>			
Old east pier removed .....	cubic yards.. 6,270	.50	3,135.00
Dredging crib foundation .....	do. 10,575	.25	2,643.75
Hemlock timber .....	feet B. M.. 209,946	28.50	5,983.46
Beech timber .....	do. 18,432	36.00	668.56
Tie-rods and washers .....	pounds.. 13,125	.04	525.00
Driftbolts .....	do. 13,330	.04	533.20
Screw bolts and washers .....	do. 18,433.8	.04	737.35
Lag screws and washers .....	do. 10,890	.04	435.63
Spikes .....	do. 258	.04	10.32
Small riprap stone, for crib filling .....	tons.. 2,000	1.33	2,660.00
Small riprap stone, for foundation .....	do. 300	1.33	399.00
<i>Sheathing and repairing old piers.</i>			
3" beech plank .....	feet B. M.. 6,887	123.00	840.95
Lag screws and washers .....	pounds.. 2,039.4	.04	81.58
			30,470.62

*Dredging.*—A survey of the outer harbor, made through the ice, between January 14 and 26, 1903, showed that while considerable shoaling had taken place all over the area protected by the section of west breakwater in place, that a depth of about 19 feet was available everywhere in the prolongation of the jettied channel. Notwithstanding this favorable showing it was decided to make the usual provision for dredging through the bar at the entrance to the jettied channel, and, after the necessary proceedings, a contract for excavating 15,000 cubic yards of material, at 31 cents per cubic yard, was entered into with Rogers & O'Brien of Buffalo, N. Y., on March 17, 1903. The contractors reached Fairport with their dredge the *General Meade* on April 17, and actual work was commenced on the 20th. Soundings made in advance of the dredging showed a very considerable fill had taken place since the survey made in January, and that the depth available in the channel was only 17 feet.

Two cuts were immediately made through the crest of the bar on the center line of the channel and sufficient depth and width provided that navigation was not in any way interfered with. The dredge removed a total of 15,831 cubic yards, completing the work on May 16, at a total cost, including board of inspector, of \$4,936.61.

*New work.*—The unusual movement of drift and tendency to shoal in the immediate vicinity of Fairport Harbor has always been a matter of note, and has been especially referred to and commented on in my previous reports. The construction of the shore 828 feet of the west breakwater under the present approved project has apparently had no effect in checking this tendency, and it now appears that unless some radical steps are soon taken to check the movement of drift from the westward that the crest of the shoaling will so encroach on the entrance channel that almost continuous dredging will be necessary in order to maintain it.

During the fall of 1901 an extensive series of observations were made at Fairport, under your directions, to determine the probable effect of the existing construction and secure the data necessary for the thorough study of the questions involved. These observations have not progressed far enough at this time to furnish all the information necessary for a full discussion of the question. They all point, however, to the general conclusion that, for this locality at least, it is not practicable by providing only for the resultant action or motion of the drift to prevent the formation of bars across the channel or the deposition of the drifting materials over the area protected by the length of breakwater in place. They show that the prevailing currents are from west to east. They also indicate that the presence of the west breakwater has increased the deposition of materials over the area it protects, for a large part of the material in suspension is doubtless raised from the bottom by the action of the waves, and when carried by the currents into the area protected by the breakwater, where the force, size, and lifting power of the waves is decreased, is again deposited.

The indications of all previous surveys are that there has been no material change or shoaling to the eastward of the existing piers. Accepting this fact as evidence of their efficiency in stopping the movement of the drift from the west, the plan which naturally suggests itself for the protection of the channel is the construction of a spur or groin to the westward of the entrance designed to act as a sand catch and prevent the movement of drift along the shore and across the channel. The simplest and most economical way of accomplishing this, under the existing circumstances and conditions, and at the same time providing protection against west and northwest seas, appears to be by connecting the inner end of the present structure with the shore, and by extending the outer end into the lake to about the same depth as was originally planned for the west breakwater.

A further consideration may be necessary in order to determine the best location, length, and form of construction for this work, but for present purposes the type of rubble mound breakwater without paved slopes, designed by you for the extension of the west breakwater at Ashtabula Harbor, which is well suited to the location, will be used as a basis of estimating the cost. This type of breakwater will be of low first cost, can be easily and economically repaired, and being comparatively open will allow a sufficient flow of water through it to prevent the stagnation of the harbor. It is now proposed to make the extensions of the existing breakwater parallel to the present piers. The length of the shore connection will be approximately 1,200 feet and the average depth of water about 12 feet. The length of the lake extension will also be about 1,200 feet and the average depth of water about 25 feet. The cost of constructing the shore connection will be somewhat increased by the shallowness of the water which will necessitate the rehandling nearly of all the material for the inner 600 feet.

The total cost of the extensions herein outlined is estimated as follows:

One 50 by 50 feet pierhead complete.....	\$18,500
126,000 tons large and heavy riprap stone, at \$1.50 per ton .....	189,000
18,000 tons small riprap stone, at \$1.30 per ton .....	23,000
24,000 cubic yards sand filling, at 50 cents per cubic yard .....	12,000
Extra cost of constructing shore end.....	5,000
10 per cent for supervision and contingencies.....	24,790
<b>Total .....</b>	<b>272,690</b>

The work at Fairport Harbor is being executed under the local supervision of Inspector J. N. Winn.

Very respectfully,

Maj. DAN C. KINGMAN,  
Corps of Engineers.

G. T. NELLIS,  
United States Assistant Engineer.

## R R 9.

## IMPROVEMENT OF ASHTABULA HARBOR, OHIO.

For a description of the location, original condition, and the various projects of improvement, see page 2679 of the Annual Report of the Chief of Engineers, 1898.

The present project was adopted in 1896.

The improvement of this harbor is being carried on under a continuous contract which was approved June 22, 1900, with the Donnelly Contracting Company, of Buffalo, N. Y. The work under this contract will secure the completion of the breakwaters.

At the end of the last fiscal year about 26 per cent of the work had been completed. It was continued during the year and resulted in the completion of the pierheads and the building of the greater portion of the substructure of the rubble mound breakwaters. At the end of the fiscal year 1903 the work was about 60 per cent completed.

No work has yet been done upon the rubble mound breakwater above the surface of the water. At the close of the working season of 1902, the mound had been carried up to within about 10 feet of the surface, and at certain points to within 7 feet of the surface. It remained in this condition exposed to the storms of the winter, and although the core, which consists of small stone, was exposed to the action of the waves throughout the winter, comparative surveys show that there was no displacement of the material. This fact is interesting as showing that the waves upon Lake Erie have not sufficient force to move small stone at a depth of 10 feet below the water surface. The contractor is making satisfactory progress, and there is every reason to believe that the work will be completed within the time fixed.

The river and harbor act of June 13, 1902, appropriated the sum of \$200,000 for continuing improvement and for maintenance. It was intended to apply three-fourths of this sum to the complete rebuilding of the west jetty, which was in a ruinous condition, but while plans were in preparation for this work, and before the project had been submitted, the Secretary of War gave permission to the Pittsburgh, Youngstown and Ashtabula Railroad Company to completely remove the west jetty and to replace the same by a bulkhead 60 feet farther west, this company being the owner of the land lying immediately west of the jetty. This authority completely relieves the United States of the necessity of completing this jetty and of maintaining it in the future, and it left available \$150,000 for any improvement elsewhere.

A project was prepared and submitted October 27, 1902, to apply this sum to the extension of the west breakwater, 1,500 feet shoreward, the style of construction to be a modified rubble mound. It was held, however, that this work being outside of the approved project could not be done without the authority of Congress. Congress has not yet sanctioned the work, but the expenditure would seem to be best for the improvement of the harbor because the railroad company above mentioned is desirous, in case the work is done, of constructing docks under the shelter which it will afford to the westward of the present jetty. The additional wharf roof room is greatly needed at the harbor, for the resources are now taxed to the very limit to accommodate the business of the port.

The Lake Shore and Michigan Southern Railroad Company, acting under authority of an act of Congress, has completed the removal of the inner end of the old east jetty and has replaced it by a substantial bulkhead built 45 feet farther east, thus correspondingly widening the channel. The company has at the same time deepened this increased area by dredging to 21 feet.

In the spring of 1903 examinations showed that the usual shoaling and bar formation had occurred. A narrow channel of 20 feet, however, was still in existence through the obstruction and the high stage of the lake in the early spring prevented any serious interference with navigation. Proposals were invited in February for the removal of this obstruction and an emergency contract was entered into March 17, 1903, but the work of dredging was not completed until June 26, which, under different circumstances, might have resulted in great inconvenience to commerce. The construction of a suitable seagoing hydraulic dredge, which has recently been authorized, will hereafter enable the United States to remove these obstructions in a much more economical and efficient manner.

The commerce of Ashtabula is very great and is continually increasing. During the calendar year 1902 the receipts and shipments exceeded 7,000,000 tons, an increase of more than a million tons over the business of the previous year.

For a detailed description of the work done during the present fiscal year, attention is respectfully invited to the report of Assistant Engineer Howard E. Smith, which is transmitted herewith.

\* \* \* \* \*

#### *Money statement.*

July 1, 1902, balance unexpended .....	\$468, 988. 02
Amount appropriated by sundry civil act approved March 3, 1903 .....	118, 000. 00
December 4, 1902, proceeds of sales of Government property .....	1. 00
	<hr/>
	586, 989. 02
June 30, 1903, amount expended during fiscal year .....	148, 814. 03
	<hr/>
July 1, 1903, balance unexpended .....	438, 174. 99
July 1, 1903, outstanding liabilities .....	13, 657. 95
	<hr/>
July 1, 1903, balance available.....	424, 517. 04
	<hr/>
July 1, 1903, amount covered by uncompleted contracts.....	183, 620. 64
	<hr/>
<div style="display: flex; align-items: center;"> <div style="font-size: 3em; margin-right: 10px;">{</div> <div>           Amount that can be profitably expended in fiscal year ending June 30, 1905, for maintenance of improvement, in addition to the balance unexpended July 1, 1903.....         </div> <div style="margin-left: 20px; text-align: right;">10, 000. 00</div> </div>	
<div style="display: flex; align-items: center;"> <div style="font-size: 3em; margin-right: 10px;">{</div> <div>           Submitted in compliance with requirements of sundry civil act of June 4, 1897, and of section 7 of the river and harbor act of 1899.         </div> </div>	

## AMOUNT AND DATE OF ALL APPROPRIATIONS.

May 26, 1826.....	\$12,000.00	August 5, 1886.....	\$30,000.00
May 19, 1828.....	2,403.50	August 11, 1888.....	25,000.00
March 3, 1829.....	6,940.25	September 19, 1890.....	40,000.00
March 2, 1831.....	7,015.00	July 13, 1892.....	70,000.00
July 3, 1832.....	3,800.00	August 18, 1894.....	75,000.00
March 2, 1833.....	3,400.00	June 3, 1896.....	50,000.00
June 23, 1834.....	5,000.00	March 3, 1899.....	50,000.00
March 3, 1835.....	7,591.00	June 6, 1900.....	110,000.00
March 3, 1837.....	8,000.00	July 2, 1900 (allotment)...	3,000.00
July 7, 1838.....	8,000.00	March 3, 1901.....	2,000.00
June 11, 1844.....	5,000.00	April 30, 1901	
August 30, 1852.....	10,000.00	(allotment) ..	\$3,000.00
March 3, 1853.....	42.60	Redeposited	
June 23, 1866.....	24,708.82	April 19, 1902..	141.55
March 2, 1867.....	54,000.00		2,858.45
March 3, 1871.....	15,000.00	June 13, 1902.....	200,000.00
June 10, 1872.....	15,000.00	June 28, 1902.....	200,000.00
March 3, 1873.....	16,000.00	March 3, 1903.....	118,000.00
June 23, 1874.....	35,000.00	December 4, 1902 (proceeds	
March 3, 1875.....	25,000.00	of sale of Government	
August 14, 1876.....	5,000.00	property) .....	1.00
June 18, 1878.....	12,000.00		
March 3, 1879.....	9,000.00	Total .....	1,348,260.66
June 14, 1880.....	20,000.00	Expended to June 30, 1903..	910,085.67
March 3, 1881.....	20,000.00		
August 2, 1882.....	20,000.00	Unexpended July 1, 1903..	438,174.99
July 6, 1884.....	22,500.00		

## LIST OF CONTRACTS IN FORCE DURING THE FISCAL YEAR ENDING JUNE 30, 1903.

*Contract for constructing east and west breakwaters.*

Name of contractor: The Donnelly Contracting Company, Buffalo, N. Y.

Date of contract: May 15, 1900.

Date of approval: June 22, 1900.

Date of commencement: October 1, 1900.

Date of completion: Continuous contract.

## COMMERCIAL STATISTICS.

The following statistics for the year 1902 relative to the commerce of the harbor of Ashtabula, Ohio, were compiled from information furnished by the collector of customs and by the owners of vessels that visited the port:

Receipts.	Tons.	Shipments.	Tons.
Coal and coke .....	1,872	Coal and coke.....	1,490,295
Grain and produce .....	2,432		
Iron ore.....	5,400,169		
Iron and structural steel .....	10		
Lumber, logs, etc.....	60		
Sand and gravel.....	79,150		
Stone.....	89,679		
Total.....	5,572,872	Total .....	1,490,295

## Total freight tonnage:

1902 .....	7,063,167
1901 .....	6,003,636

Increase .....	1,059,531
----------------	-----------

# 2096 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

Vessels.	Number.	Tonnage.
Entering .....	1,858	3,156, 827
Departing .....	1,877	3,154, 263
Built .....	2	90

Total registered tonnage (vessels entering and departing):

1902 .....	6,811, 090
1901 .....	5,193, 383

Increase ..... 1,117, 707

Draft of largest vessels using harbor, 20 feet.  
Largest vessels do not load to full depth.  
No new vessel lines established during the year.

## REPORT OF MR. H. E. SMITH, ASSISTANT ENGINEER.

ASHTABULA, OHIO, June 30, 1903.

MAJOR: I have the honor to submit the following report of operations at Ashtabula Harbor, Ohio, for the fiscal year ending June 30, 1903:

Construction work has been in progress during the year, under continuous contract with the Donnelly Contracting Company, dated May 15, 1900, for constructing two breakwaters of the rubble-mound type, and two pierheads with stone-filled timber substructures and concrete superstructures terminating the outer ends of the breakwaters.

*Breakwater construction.*—The work on the west breakwater was commenced August 14, 1901, and was in progress at the opening of the fiscal year. Work on the east breakwater was commenced on July 24, 1902. The last-named breakwater makes an angle of 135° with the line of outer faces of the pierheads. A transit was employed in laying out the breakwater, and ranges were established on shore which were used during construction. No new methods or features of construction have been introduced during the year that are notable. In the west breakwater the two ridges of heavy riprap at the base of the structure on either side have been completed to very nearly finished height of 12 feet below mean lake level on the westerly side, and 8 feet below mean lake level on the easterly side, covering practically the entire length of 1,370 feet. The riprap has been placed, for the most part, by dumping from pocket scows, and, in consequence, the tops of ridges are somewhat irregular. A derrick scow will be employed to level up the ridges and finally complete them. The interior mass, composed of gravel from the Niagara River, shale from the Ashtabula River, and small riprap from Kelley Island, has been dumped in place from pocket scows or shoveled into the work from barges.

In the east breakwater the easterly ridge of riprap is completed, except for the final leveling up, by placing stones with a derrick scow. The westerly ridge is partially completed, the top being about 18 feet below mean lake level. The interior mass, composed of gravel from the Niagara River, shale from the Ashtabula River, and small riprap from Kelley Island, has been placed throughout its entire length of 1,200 feet.

To guard against possible displacement of the interior filling during the heavy seas of winter, the material was so disposed that its top should not be higher than 10 feet below lake surface. This condition was generally attained in both breakwaters, but in some instances the material was found to be only 7 feet below lake surface. Comparative soundings showed that there was no displacement of the material during the winter season.

In order to note the disposition of the material that was put into the work, cross-section soundings were made over the breakwater at frequent stations, and a row-boat was used in this connection. This method did not give results sufficiently accurate, so in August, 1902, a sounding float was built. The float was made 120 feet long and 6 feet wide. Two side stringers, 6 inches thick and 16 inches high, built up of 2 by 6 inch hemlock lumber, were connected by a decking 2 inches thick and a bottom 4 inches thick. In addition, there was interior diagonal bracing to give it horizontal stiffness. All the lumber entering into the float was thoroughly coated with coal tar applied hot, for its floating capacity was dependent wholly upon the buoyancy of the lumber. The extreme height of the float was 22 inches, and its draft was about 16 inches. With this float soundings were taken at 5-foot intervals on the cross sections, and cross sections were taken at 25-foot intervals and at 10-foot intervals, according to the requirements of the work.



Work on the breakwaters was suspended on December 24, 1902, and resumed April 7, 1903. The work of the present season has been restricted to the 300 feet of west breakwater, immediately outside the timber breakwater, except that material has been placed elsewhere in the west breakwater below the plane of 10 feet below lake surface wherever required.

The concrete superstructure of the west pierhead was completed during the preceding fiscal year. Concrete blocks were being placed on the east pierhead at the opening of the present fiscal year. This work was delayed because of repairs necessary to the corner of the crib, requiring the services of a diver. The repair work continued into the month of September, with frequent interruptions on account of unfavorable weather.

After the concrete blocks had been repeatedly displaced by storm, and replaced, and the timber forms had suffered disaster by storm, at your suggestion and with your permission, a second course of concrete blocks was placed on top of the course provided for in the specifications, making the top of blocks about 4 feet above lake surface. Then the timber forms were attached thereto and the mass concrete was placed. There was no further accident, and the concrete work was finished November 20, thus completing the east pierhead excepting the oak fender.

The progress on the breakwaters and pierheads is denoted by the following table:

Items.	Total to date.		Total required.		Per cent completed.
	Quantity.	Price.	Quantity.	Price.	
<b>Pierheads:</b>					
Foundation stone.....tons.....	6,737	\$8,488.62	6,737	\$8,488.62	100
Concrete blocks.....cubic feet.....	9,650	3,956.50	9,650	3,956.50	100
Mass concrete.....cubic yards.....	740	6,216.00	740	6,216.00	100
Filling in superstructure.....tons.....	191	229.20	790	948.00	24.1
Oak fenders.....M feet.....	0	0	2,100	96.50	0
Bolts, washers, and collars.....pounds.....	0	0	9,000	36.00	0
Wrought-iron pipe.....do.....	0	0	225	22.50	0
Paving stone.....tons.....	0	0	82	196.80	0
Crib structures.....		16,356.04		16,356.04	100
<b>West breakwater:</b>					
Heavy riprap.....tons.....	34,017½	48,644.68	37,000	52,910.00	91.9
Core filling.....do.....	65,771½	50,644.06	70,000	58,900.00	93.9
Small stone.....do.....	33,111	38,408.78	39,000	68,440.00	56.1
Paving stone.....do.....	0	0	18,000	37,620.00	0
<b>East breakwater:</b>					
Heavy riprap.....do.....	12,931½	18,492.04	22,500	32,175.00	57.4
Core filling.....do.....	39,552	30,455.04	45,000	34,650.00	87.9
Small stone.....do.....	16,027	18,591.32	49,000	56,840.00	32.7
Paving stone.....do.....	0	0	15,500	32,395.00	0
<b>Total.....</b>		240,482.26		405,247.06	59.3

## SURVEYS OF CHANNEL.

Between December 9 and December 24, 1902, a survey was made of the channel between piers and of the channel outside of piers, to deep water of lake. A bar was in process of formation from the westward 400 feet outside the end of the west pier. On the east side there had been a general movement of sand for a distance of 500 feet from the end of the east pier toward the center of the channel. There was, however, a depth of 20 feet or over in the center of the channel outside of piers. A survey was again made between March 23 and March 30, 1903. A bar had formed across the channel about 400 feet outside the west pier, over which there was a depth of 19.2 feet in mid channel. Between the bar formation and the ends of the piers the sand had encroached upon the channel from either side, contracting it to less than 20 feet. The lake was unusually high at the opening of navigation the current season and loaded vessels were able to enter and leave the harbor without difficulty.

## DREDGING.

A circular letter was issued on February 10, 1903, inviting proposals for dredging at Ashtabula Harbor, to be opened March 16, 1903. The contract was awarded March 17 to W. A. McGillis & Co., of Cleveland, Ohio, at \$0.30 per yard and board of \$1 a day each for inspector and one assistant. The work was commenced on May 5 and was completed June 26.

Ten thousand three hundred and seventy-three cubic yards of material were removed, and its value at the contract price, including the board of one inspector for eleven days, was \$3,122.90.

# 2098 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

## INJURIES AND REPAIRS TO EXISTING STRUCTURES.

On November 22, 1902, the steamer *M. A. Hanna*, in attempting to enter the harbor without the assistance of a tug, collided with the outer end of the east pier, breaking and shattering the timbers for a distance of about 20 feet back from the end.

In my letter to you of November 29, 1902, I stated that the cost of making temporary repairs was estimated to be \$1,100, and that the cost of preparing the end of the pier for the new work and removing the débris was estimated to be \$1,500. The nature of the injury was such as to render it difficult to make a close estimate of the cost of repair. You therefore decided to advertise for the work to be done on labor account.

A circular letter was issued May 27, 1902, inviting proposals for making the repair. Proposals were opened on June 6, 1903, and the bid of J. G. Laird & Sons was accepted. They are making active preparations to commence the work, and a start will no doubt be made shortly after the opening of the next fiscal year.

On December 17, 1902, the steamer *Van Hise*, of the Pittsburg Steamship Company, collided with the southwest corner of the east pierhead, breaking off a piece of the concrete superstructure. The cost of making repairs was estimated to be \$150.

## REMOVAL OF GOVERNMENT PIERS AND WIDENING OF RIVER CHANNEL.

A portion of the old east pier was removed in May, 1902, by the Lake Shore and Michigan Southern Railway Company, and the railroad company commenced to build a new dock 45 feet from the face of the old pier and to construct a new slip about 700 feet long. The work has continued without interruption to the present time. The dock and slip are structurally completed, and the material has been removed in front of the dock to the required depth of 21 feet, thereby fulfilling the final condition under which authority was granted by the Secretary of War to make said improvements.

On January 31, 1903, the Pennsylvania Company, under authority granted by the Secretary of War, commenced certain improvements on the westerly side of the Ashtabula River. Said improvements contemplate the removal of about 1,000 feet of the old west pier and revetment, the construction of a new dock of equal length 60 feet back from the line of the old work, and dredging in the area between the line of the old pier and the new dock to a depth of 21 feet, referred to mean lake level. A considerable part of the dredging has been done, and over 900 linear feet of crib work has been built, but only one crib has thus far been sunk into position.

## LAKE LEVELS.

Gauge observations indicating the level of Lake Erie at Ashtabula Harbor, Ohio, have been made three times daily during the fiscal year. The zero plane of reference is the mean level from lake, established by observations covering the sixteen years from 1860 to 1875.

The highest, lowest, and mean elevations of lake surface during the fiscal year ending June 30, 1903, are shown in the following table:

Month.	Highest elevation.	Lowest elevation.	Mean elevation.
1902.			
July .....	<i>Fect.</i> +0.60	<i>Fect.</i> -0.30	<i>Fect.</i> +0.206
August .....	+ .60	- .20	+ .160
September .....	.00	- .60	- .246
October .....	.00	- .60	- .257
November .....	- .20	- .90	- .571
December .....	- .20	-1.00	- .686
1903.			
January .....	- .30	-1.10	- .827
February .....	- .20	-1.30	- .765
March .....	.00	- .80	- .332
April .....	+ .70	.00	+ .411
May .....	+ .80	+ .20	+ .437
June .....	+ .70	+ .30	+ .424
For fiscal year .....	+ .80	-1.30	- .170

NOTE.—Elevations above zero marked thus: "+". Elevations below zero marked thus: "-".

Very respectfully,

HOWARD E. SMITH,  
Assistant Engineer.

Maj. DAN C. KINGMAN,  
Corps of Engineers.

## R R 10.

## IMPROVEMENT OF CONNEAUT HARBOR, OHIO.

The project for the improvement of this harbor was adopted in its present form in 1896, and is given in full on pages 2970 and 2971 of the Report of the Chief of Engineers for that year.

The river and harbor act of June 13, 1902, authorized the expenditure of \$450,000 for the prosecution of this project. Of this sum \$200,000 was appropriated by the act. On the basis of prices previously obtained it was thought that this amount would be sufficient for the completion of the project and for necessary work of repair and maintenance. A plan and specifications were prepared for carrying out the work by contract, and was submitted for approval July 21, 1902. Proposals were invited in due course, and the bids were opened October 21, 1902. The competition was a satisfactory one, but the rapid advance in the cost of labor and material which had taken place forced the prices above the estimate. There was no reason to believe that a readvertisement would produce any reduction in the cost and the lowest bid, that of the Donnelly Contracting Company, of Buffalo, N. Y., was recommended for acceptance.

A contract was entered into with this firm, and was approved December 22, 1902. This contract provides for building 175 feet at the outer end of the existing west breakwater. The structure is to be a timber crib surmounted by a timber superstructure to conform to the work already built. It also provides for the construction of two pierheads 50 feet square for the breakwaters, these to be built of timber cribs with concrete tops of the standard type. It provides for extending the east jetty 452 feet and the west jetty 150 feet; for completely rebuilding 518 feet of the inner end of the west jetty and 412 feet of the inner end of the east jetty, and for thoroughly repairing 603 feet of the existing east jetty and 403 feet of the west jetty. All of the jetty construction when completed will be of timber cribs with concrete tops. In addition, the contract provides for building 750 feet of the east breakwater, this to be of the standard rubble mound type. It leaves only 250 feet of the east breakwater to be provided for by future appropriations. This will cost on the basis of the prices of the contract, and including the cost of inspection \$40,000, and the appropriation of this amount is recommended for the completion of the project.

The time of the completion of the contract is fixed as November 15, 1906, but the contractor declares that it is his intention to complete it at least a year earlier, and the plant at his disposal would seem to render this very easy to accomplish. The contract was approved too late to permit the beginning of work in 1902. The harbor of Conneaut affords no locality suitable for the construction of cribs, and the contractor has installed his crib-building plant at Fairport and proposes to build the cribs at that place and tow them to Conneaut. He has abundant ground at Fairport and a suitable steam and compressed air plant for the rapid execution of the work. A large amount of timber has been received and stored at that place.

The work actually accomplished at Conneaut is limited to the preparation of the foundation for the extension of the west breakwater and the partial completion of the foundation for the west pierhead.

Some portion of the old superstructure of the jetties has been removed as a preliminary to their rebuilding.

The usual shoaling in the jettied channel, and the usual formation of a bar outside the jetties, took place during the winter of 1903. An emergency contract was resorted to to secure the removal of the obstruction. This was accomplished by dredging some 10,500 cubic yards of material, the field cost being \$2,837.16, exclusive of the cost of inspection. There is not the slightest reason to hope that the necessity for this annual dredging for the purpose of maintenance will ever cease. On the contrary it will probably become more extensive and more imperative as the area on each side of the channel beyond the jetties becomes shallower.

For a detailed account of the operations at this harbor, attention is respectfully invited to the report of Assistant Engineer Howard E. Smith, which is transmitted herewith.

The harbor of Conneaut has had a remarkable history. Its improvement was originally undertaken in 1829, at which time the depth at the mouth of the creek was too slight to permit the passage of even the small vessels at that period. An improvement by parallel jetties was undertaken with a view to obtaining, if possible, a depth of 12 feet. This was accomplished about 1870, and for ten years thereafter but little was done except to partially maintain the existing improvement. For twelve years thereafter, until 1892, nothing at all was done and no money appropriated. During this period the piers decayed, the channel deteriorated, and the harbor practically returned to its original condition. In 1892 an appropriation was made for the restoration of the harbor. But little was left of value of the old work.

In 1893 the harbor had no commerce at all. In 1902 this commerce amounted to more than 5,250,000 tons. Nine-tenths of this was iron ore brought down from the upper lakes for the use of the furnaces near the city of Pittsburg. The harbor, though small, is admirably equipped with machinery and appliances for unloading and forwarding this ore, and there is every reason to believe that the commerce will continue to increase.

\* \* \* \* \*

*Money statement.*

July 1, 1902, balance unexpended .....	\$201, 813. 41
Amount appropriated by sundry civil act approved March 3, 1903 .....	10, 000. 00
	<hr/>
June 30, 1903, amount expended during fiscal year .....	211, 813. 41
	7, 472. 20
July 1, 1903, balance unexpended .....	204, 341. 21
July 1, 1903, outstanding liabilities .....	264. 28
	<hr/>
July 1, 1903, balance available .....	204, 076. 93
	<hr/>
July 1, 1903, amount covered by uncompleted contracts .....	432, 646. 84
	<hr/>
{ Amount (estimated) required for completion of existing project .....	240, 000. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1905, in addition to the balance unexpended July 1, 1903:	
For works of improvement .....	\$240, 000. 00
For maintenance of improvement .....	6, 000. 00
	<hr/>
	246, 000. 00
{ Submitted in compliance with requirements of sundry civil act of June 4, 1897, and of section 7 of the river and harbor act of 1899.	

## AMOUNT AND DATE OF ALL APPROPRIATIONS.

March 3, 1829 .....	\$7,500.00	July 13, 1892 .....	\$40,000.00
April 23, 1830 .....	6,135.65	August 18, 1894 .....	40,000.00
March 2, 1831 .....	6,370.00	June 3, 1896 .....	40,000.00
July 2, 1832 .....	7,800.00	March 3, 1899 .....	100,000.00
July 2, 1836 .....	2,500.00	July 2, 1900 (allotment) .....	3,000.00
March 3, 1837 .....	5,000.00	March 30, 1901	
July 7, 1838 .....	8,000.00	(allotment) .....	\$2,500.00
June 11, 1844 .....	5,000.00	Redeposited April	
August 30, 1852 .....	10,000.00	19, 1902 .....	431.80
June 23, 1866 .....	20,513.74		2,068.20
March 2, 1867 .....	10,000.00	June 13, 1902 .....	200,000.00
April 10, 1869 (allotment) .....	8,910.00	March 3, 1903 .....	10,000.00
June 11, 1870 .....	6,000.00		
March 3, 1873 .....	400.00	Total .....	547,697.59
June 23, 1874 .....	1,500.00	Expended to June 30, 1903 .....	343,356.38
March 3, 1875 .....	1,000.00		
June 14, 1880 .....	6,000.00	Unexpended July 1, 1903 .....	204,341.21

## LIST OF CONTRACTS IN FORCE DURING THE FISCAL YEAR ENDING JUNE 30, 1903.

*Contract for construction of breakwaters, the extension of and the reconstruction of east and west piers.*

Name of contractor: The Donnelly Contracting Company, Buffalo, N. Y.

Date of contract: November 14, 1902.

Date of approval: December 22, 1902.

Date of commencement: April 14, 1903.

Date of completion: Continuous contract.

## COMMERCIAL STATISTICS.

The following statistics for the year 1902 relative to the commerce of the harbor of Conneaut, Ohio, were compiled from information furnished by the collector of customs and by the owners of vessels that visited the port:

Receipts.	Tons.	Shipments.	Tons.
Fish .....	6	Coal and coke .....	407,826
Grain and produce .....	1,639	Iron and steel (structural) .....	46,719
Iron ore .....	4,816,449	Merchandise .....	698
Iron (pig) .....	3,321	Miscellaneous .....	2,780
Lumber, logs, etc .....	7,039	Total .....	458,018
Merchandise .....	106		
Salt .....	88		
Total .....	4,828,598		

Total freight tonnage:	
1902 .....	5,286,611
1901 .....	3,955,078
Increase .....	1,331,533

Vessels.	Number.	Tonnage.
Entering .....	1,201	2,995,775
Departing .....	1,201	2,995,775

Total registered tonnage:	
1902 .....	5,991,550
1901 .....	4,827,542
Increase .....	1,164,008

Draft of largest vessels using harbor, 20 feet.

Largest vessels do not load to full depth.

No new vessel lines established during the year.

# 2102 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

REPORT OF MR. H. E. SMITH, ASSISTANT ENGINEER.

ASHTABULA, OHIO, *June 30, 1903.*

**MAJOR:** I have the honor to submit the following report of operations at Conneaut Harbor, Ohio, for the fiscal year ending June 30, 1903:

The boring and sounding operations that were commenced June 2 of the preceding fiscal year were continued into the present fiscal year. The work was interrupted by a number of days of unfavorable weather (ten days in all) but was finally completed on July 8, 1902. The borings and soundings were made along the line of the proposed new piers and breakwaters, to assist in the preparation of plans and specifications as a basis of a contract for the improvement of Conneaut Harbor, in pursuance of the approved project of 1896. On completion of this work the information I had obtained was sent to you and was embodied in the new plans and specifications then in preparation.

Under date of September 22, 1902, proposals were invited for the construction of parts of the east and west breakwaters, extension and reconstruction of parts of the east and west piers, in accordance with the approved project.

Bids were received for constructing the west breakwater extension of timber, filled with stone, resting on a prepared stone foundation, and for building the east breakwater in accordance with one of two types: (1) Of stone, known as the rubble mound type, and (2) of timber with stone filling, resting on a prepared stone foundation and surmounted by a concrete superstructure. Bids were also received for constructing new piers, consisting of stone-filled timber structures 18 feet wide (except one section 150 feet long, which is to be 24 feet wide) with grillage bottoms 26 feet wide, resting on a prepared stone foundation 20 feet below lake level at mean stage, and surmounted by a concrete superstructure rising to a height of 6 feet above mean level of lake.

The contract was awarded to The Donnelly Contracting Company under agreement dated November 14, 1902.

Work was commenced April 14, 1903, on the foundation for the west breakwater extension. Heavy riprap stone was first dumped in two parallel ridges, whose crests are 50 feet apart, and which will be 10 feet away from the faces of the crib on each side when the latter has been placed. The height of the riprap stone was made about 4 feet.

The space between the two ridges of heavy riprap stone was filled with small riprap stone to a height of 22 feet below mean lake level. In continuation of the foundation of the breakwater, the foundation for the west pierhead was made. Heavy riprap stone was dumped in ridges around the three outer sides of a square, and the crests of the ridges will be 10 feet away from the faces of the pierhead crib. The height of the heavy riprap stone was made about 4 feet. Small riprap stone was placed in the area within to a height of 22 feet below mean lake level. Work on the foundation was not entirely completed, and was temporarily suspended May 4, 1903.

The progress under this contract, to date, is denoted by the following table:

	Quantity placed.	Unit price.	Value.
<b>West breakwater:</b>			
Heavy riprap stone.....tons.	528	\$1.65	\$871.20
Small riprap stone.....do.	1,244	1.55	1,679.40
<b>West pierhead:</b>			
Heavy riprap stone.....do.	257½	1.65	589.88
Small riprap stone.....do.	204	1.55	271.52
<b>Total value of work done .....</b>			<b>3,411.80</b>

## SURVEYS OF CHANNEL.

Between January 3 and January 10, 1903, a survey was made of the channels. There was no bar formation across the channel outside of piers. The sand had drifted into the channel very little from the westward, but the encroachment of sand from the eastward had been considerable, contracting the channel to about half its usual width. The full dredged depths of over 20 feet obtained in the contracted channel, however.

A survey of the channel was again made on March 31 and April 1, 1903. During the three months interval there had been very little movement of sand on the east side of the channel, but on the west side of the channel the change was clearly

noticeable. A bar of sand had begun to form about 300 feet outside of the west pier, and had worked over to the center line of channel. The width of channel of 20 feet depth was 65 feet at this point, and here its width was a minimum.

#### DREDGING.

A circular letter was issued on February 10, 1903, inviting proposals for dredging at Conneaut, to be opened March 16, 1903. The contract was awarded March 17, 1903, to George H. Breyman & Brothers, of Toledo, Ohio, at \$0.27 per cubic yard and board of \$0.50 a day each for inspector and assistant. The contract provided that the work should be commenced by April 16 and completed within sixty days thereafter.

At the opening of navigation, in 1903, the lake level was unusually high and has continued high to the present time. Because of the high stage of water, coupled with the fact that the channel was slightly more favorable to navigation than obtained in 1902 at opening of navigation, vessels were able, under careful pilotage, to enter and depart without difficulty before the commencement of the dredging.

The work was commenced April 27 and was completed on May 12, 1903. Ten thousand five hundred and eight cubic yards of material were removed, and one inspector was boarded by the contractor for thirteen days. The total value of the work at the contract price was \$2,843.66.

#### INJURIES TO EXISTING STRUCTURES.

On July 21, 1902, the steamer *Mecosta*, owned by J. C. Gilchrist, collided with the outer end of the west pier, breaking the end cross wall and otherwise injuring the structure. In my letter to you of September 3, 1903, I recommended that the pier be repaired by cutting off the end of the pier  $1\frac{1}{2}$  feet forward of the second cross wall from the end, that the outer end be sheathed with oak, and that tie-rods be inserted to hold the side walls together. The estimated cost of the work was \$880.

In order to guard against further injury by storm during the winter, temporary repair was made to the end of pier by placing 3 tie-rods immediately back of the end wall, the lower one at about mean lake level. The work was done between October 30 and November 4, 1902. Since this repair was made there has been no displacement of the broken timbers or the stone filling.

On the morning of May 30, 1903, the steamer *George Stephenson* collided with the west breakwater, head on. The steamer struck the harbor side of the breakwater about 50 feet from the outer end and midway between two cross walls, breaking the timbers and driving them in for full height of 5 feet above water and 4 or 5 feet below water. No hole was made through which the stone filling has passed.

Very respectfully,

HOWARD E. SMITH, *Assistant Engineer.*

Maj. DAN C. KINGMAN, *Corps of Engineers.*

---

#### R R II.

#### REMOVING SUNKEN VESSELS OR CRAFT OBSTRUCTING OR ENDANGERING NAVIGATION.

##### STEAMER GEORGE DUNBAR.

The steamer *George Dunbar* foundered in Lake Erie in about 44 feet of water, 6 miles east of Middle Island light-house, on the 29th of June, 1902. On the 7th of July, 1902, I received a notification from the Saginaw Bay Company, the owners of the *Dunbar*, that they intended to abandon the wreck. I caused the wreck to be sought for by the inspection boat belonging to the district, but the location given by the owners was incorrect and the wreck could not be found. On the 16th of July the master of the steamer *State of New York* reported that he had seen the wreck and described its location. It was at a considerable distance from the point described by the owners. With

the help of this description the wreck was easily found, and on the 18th of July it was buoyed and located by sextant angles. An examination showed that the wreck was a dangerous obstruction to navigation, and it was thought to be necessary to remove its spars and upper works so as to afford a depth of not less than 30 feet of water over it. The estimated cost of the work was \$500, and a report and estimate was submitted on the 24th of July, 1902.

An allotment of \$500 was made by authority of the Secretary of War on July 30, 1902, and proposals were invited for its removal. The matter was advertised with ten days' notice in a Detroit and a Cleveland newspaper, and only two bids were received in response to the advertisement. These bids were \$942 and \$1,350, respectively, with an additional charge of \$1 a day board for United States inspector. The prices were so far in excess of the estimate that the bids were rejected and an effort was made to secure the removal of the wreck in open market. An agreement was finally made with Mr. E. J. Dodge, of Put in Bay, Ohio, to remove the wreck in accordance with specifications for the sum of \$400, with an additional payment at the rate of \$20 for board of United States inspector. This agreement was reduced to writing and was signed on the 26th day of September, 1902, and the actual work of removal was begun soon afterwards. On the 24th of October, 1902, it was reported by the inspector that the wreck had been completely removed to a depth of not less than 30 feet at mean level of Lake Erie, and payment was made to the contractor accordingly.

The following is a statement of expenditures connected with the removal of the wreck:

E. J. Dodge, contractor .....	\$400.00
Services of steamer <i>Visitor</i> .....	18.35
Services of assistant engineer .....	7.50
Services of inspector .....	33.33
Traveling expenses, inspector .....	5.40
Board of inspector .....	6.00
Advertising .....	11.88
Telegrams .....	2.43
Coal .....	15.11
Total .....	500.00

#### STEAMER QUITO.

On November 25, 1902, the steamer *Quito* went ashore and was wrecked just eastward of the entrance to the harbor of Lorain, Ohio. It was a wooden steamer of 1,372 tons gross, and was built at Bangor, Mich., in 1873.

This steamer was bound to Cleveland, Ohio, with a load of iron ore. It began to leak badly in consequence of the storm and the master attempted to put in at Lorain. After two or three unsuccessful attempts to enter the jettied channel the vessel went ashore and grounded just east of the new east jetty. The grounding was partly due to the vessel being unmanageable in consequence of the large amount of water in the hold, and partly due to the strong current setting eastward across the end of the jetties. It is said that the master failed to signal for a tug until after his vessel had stranded.

The vessel lies in about 16 feet of water, with the stern against the new east jetty, and about 200 feet inshore from the outer end. The



upper works are completely washed away, and nothing shows above the surface of the water. It does not form an obstruction to navigation, as it is situated in a place where no boat would be expected to go. It has not yet been practicable to ascertain whether the vessel damaged the jetty or not. The removal of the wreckage may be necessary if it is a menace to the jetty, or if portions of it are liable to be carried into navigable water.

#### SCHOONER A. MOSHER.

About the end of November, 1902, it was reported that the two-masted schooner *Amorette Mosher* was ashore and wrecked on Starve Island reef. This vessel, with 300 gross tonnage, was built in 1867. It was visited on December 1 by the United States inspection boat, found to be abandoned, and in a position where it was not an obstruction to navigation, and where it was liable to slip off into deep water. The wreck was visited from time to time, and in the spring of 1903 some portion of it was still visible. An arrangement was made to break it up or remove it, making use of the United States dredge, then bound from Toledo to Huron. When the dredge arrived, however, on May 13, nothing could be found of the wreck. It apparently had been completely broken up and an examination revealed no portion of it, and it is thought that it is no longer an obstruction to navigation.

#### SCHOONER HORACE H. BADGER.

On the night of June 11, 1903, the schooner *Horace H. Badger*, loaded with 275 tons of hard coal, en route from Buffalo, N. Y., to Port Clinton, Ohio, while attempting to make Cleveland Harbor for refuge, was driven broadside against the east breakwater, and sunk close to that structure, about 500 feet east of the main entrance. The vessel was completely broken up, and being out of the track of vessels it does not endanger navigation. The crew were saved by climbing from the vessel to the breakwater. The breakwater itself received no injury from the collision.

#### STEAMER CHAS. H. DAVIS.

On June 13, 1903, the steamer *Chas. H. Davis*, loaded with 550 tons of limestone, en route from Kelleys Island to Cleveland, Ohio, foundered and sunk in 38 feet of water about 3,500 feet northwest of the light on the end of the west breakwater at the main entrance to the harbor. A severe northwest gale was blowing at the time, and the vessel, in turning to enter the harbor, got into the trough of the sea, her cargo shifted, and she went down in a few minutes. The captain of the vessel was drowned, but the remainder of the crew were saved. A search was made as soon as possible for the wreck, which was located, and it was found that the upper works and spars had been carried away and that the hull was badly broken up. It lies in 38 feet of water. As soon as practicable it was examined by a diver and it was found that there was a full depth of not less than 32 feet of water everywhere over it. It is therefore not an obstruction to navigation. The vessel had a gross tonnage of 390, and was owned by E. W. Has-kin, of Saginaw, Mich.

## TOW BARGE L. L. LAMB.

On the night of August 16 the tow barge *L. L. Lamb* foundered and sank about a mile northwest of the Fairport Harbor light. This vessel was originally a schooner of 253 tons gross, and was built in 1869. It had been remodeled into a tow barge. At the time it was wrecked it was loaded with 410 tons of large riprap stone intended for use in improving the harbor at Ashtabula, Ohio. About one-fourth of this load was in the hold of the vessel and the remainder on deck. It sank in attempting to make the harbor of Fairport for refuge in time of a very severe storm.

An allotment of \$1,500 was made for the removal of this wreck and advertisements failed to produce any proposals, and it has not yet been possible to make arrangements for removing it by hired labor. An attempt has been made to keep a buoy on the wreck, but those which have been placed have either been carried away by storms or maliciously by some person. The wreck is breaking up, and the stone is scattered and may soon bury itself in the sand so as to form no obstruction. It can easily be avoided by vessels approaching the harbor. An examination of the wreck will shortly be made by a diver to determine its present condition. The amount expended for examination and for buoys was \$60.53.

## STEAMER LOCKEWOOD.

The steamer *Lockewood*, a vessel of 2,323 tons burden, was lost in Lake Erie in October, 1902. The location of the wreck was unknown for some time. Report was finally made that it had been seen and an allotment of \$500 was made for its examination. The United States survey boat was sent to find it, and it was located at a point NNW.  $13\frac{1}{2}$  miles from Fairport Pierhead light, and NE. by N.  $\frac{3}{4}$  N.  $34\frac{1}{2}$  miles from Cleveland Breakwater light. It lies in a depth of 75 feet of water. Nothing was showing except a piece of floating rigging apparently fastened to the hull. There is 55 feet of water over the hull of the wreck, but a broken mast came within 7 feet of the water surface. A buoy made of a cedar telegraph pole 32 feet long, and painted with alternate stripes of red and black, was anchored with a chain on the wreck. The owners at that time had not relinquished it. The cost of this work was \$157.89, leaving a balance of \$342.11, which will be used in making another examination of it.

## FLOATING CRIB.

Very early in the spring of 1903 a large portion of a wrecked crib was reported as grounded on the axis of the straight channel in the harbor of Toledo, Ohio, about 1 mile inward from the crib light. An examination was made of it by the assistant engineer in local charge. It proved to be a portion of an old crib, about 40 feet long, of 12 by 12 timbers bolted together. It was of such size and shape that while grounded in 21 feet of water it still showed a length of 18 or 20 feet on the water surface. A powerful tug was hired and the obstruction was towed away to a safe place near the mouth of the river where it was moored with chains to the wharf face. It was afterwards discovered that this wreckage came from certain work at the Lake Shore

and Michigan Southern Railway bridge and that the firm of George H. Breyman & Bros., who had charge of the work, were responsible for permitting the wreckage to go adrift. They acknowledged their responsibility and paid for the cost of removing the wreck. The cost amounted to \$36.61.

In addition to the foregoing there have been many cases of vessels grounding and sinking, but those have already been promptly raised by their owners without cost to the United States. There have been some cases, also, of temporary obstructions of draw openings, due to locomotives or cars running in when the bridges were opened. These were also promptly removed.

---

R R 12.

MODIFICATION AND EXTENSION OF HARBOR LINES IN MAUMEE RIVER, TOLEDO HARBOR, OHIO.

THE EDWARD FORD PLATE GLASS COMPANY,  
*Toledo, Ohio, August 7, 1901.*

DEAR SIR: We beg to hand you the inclosed petition, and have sent you under separate cover blueprints<sup>a</sup> in triplicate for establishing a dock line, as outlined in the petition, and shown on blueprints. We are particularly anxious to have this line established as early as possible, as we desire to build a dock in front of our property (shown as Block 82 on prints), which we are compelled to have in order to handle our supplies economically. We have secured the signature of every property owner along the proposed line, and pray that our petition be granted.

Yours, truly,

THE EDWARD FORD PLATE GLASS COMPANY,  
EDWARD FORD, *President.*

HON. ELIHU ROOT,  
*Secretary of War, Washington, D. C.*

[Second indorsement.]

OFFICE CHIEF OF ENGINEERS,  
U. S. ARMY,  
*August 15, 1901.*

Respectfully referred to Maj. Dan C. Kingman, Corps of Engineers, for report.

To be returned.

A. MACKENZIE,  
*Acting Chief of Engineers.*

[Third indorsement.]

UNITED STATES ENGINEER OFFICE,  
*Cleveland, Ohio, September 4, 1901.*

Respectfully returned to the Chief of Engineers, together with a detailed report of Assistant Engineer William T. Blunt, who is in local charge of improving the harbor of Toledo, Ohio. Attention is respectfully invited to his report.

---

<sup>a</sup> Not printed.

The portion of the river front occupied by The Edward Ford Plate Glass Company is near the upper end of the harbor line established in 1896. At the time that this line was established this portion of the river bank was unoccupied. No survey has been made of this portion of the river in recent years, and its exact condition is not known.

The map submitted by The Edward Ford Plate Glass Company is apparently copied from an old map, and may not represent the existing conditions correctly. The map shows that the river is very wide at this place, and that the channel is divided so as to leave an extensive middle ground, upon which the depth of water is very slight. The main channel follows the left bank, and this channel is now being improved by the United States. The property of the plate glass company is upon the right bank, and therefore upon the secondary channel.

The change in the harbor line asked for would permit this channel to be entirely filled up, and would thus disturb the regimen of the river, and would probably affect injuriously the channel along the right bank for a considerable distance below.

Before final action is taken, it would seem very desirable to make new examination of the locality and ascertain the present conditions, and so determine the probable effects of fills which a change in the harbor line would permit.

It appears from the letter of the plate glass company, which accompanies the report of Assistant Engineer Blunt, that this reasonable delay will not injuriously affect their interests, and I would therefore respectfully recommend that final action be deferred until the necessary examination and study can be made, in order that any change which may be permitted may be such as will not injuriously affect the interests of anyone.

The blueprint is returned in a separate package.

DAN C. KINGMAN,  
*Major, Corps of Engineers.*

[Fourth indorsement.]

OFFICE CHIEF OF ENGINEERS,  
U. S. ARMY,  
*September 6, 1901.*

Respectfully returned to Major Kingman, concurring in his recommendation in third indorsement hereon, and suggesting that a public hearing be held at the proper time in order that all interested parties may be apprised of any action proposed to be taken.

JAS. L. LUSK,  
*Acting Chief of Engineers.*

[Fifth indorsement.]

ENGINEER OFFICE, U. S. ARMY,  
*Cleveland Ohio, May 26, 1902.*

Respectfully returned to the Chief of Engineers with statement that an accurate survey has now been made of the portion of the Maumee River in question, and two blueprints<sup>a</sup> are forwarded to-day, in separate package, showing the area covered by the survey. This survey work was done at odd times by the assistant engineer and the boat's crew at Toledo without special cost to the United States.

---

<sup>a</sup> Not printed.

I also transmit herewith an application of the Delaware, Lackawanna and Western Railroad Company asking that the harbor line be extended on the left bank of the Maumee River.

I also transmit copies of three letters<sup>a</sup> of Assistant Engineer Blunt, referring to the matter and describing the nature and extent of the survey.

I would now respectfully recommend that before any final action be had, a public hearing be held at Toledo, Ohio, after due notice, and that all parties at interest be afforded an opportunity to be heard. I would recommend that notice of the hearing be served upon each one of the riparian owners mentioned in Assistant Engineer Blunt's letter of April 16, and that notice also be published as a news item in the Cleveland and Toledo papers.

I think that the hearing can be held without expense to the United States other than that involved in the journey by myself to Toledo, which can be utilized to inspect the work at that place.

DAN C. KINGMAN,  
*Major, Corps of Engineers.*

[Sixth indorsement.]

OFFICE CHIEF OF ENGINEERS,  
U. S. ARMY,  
May 29, 1902.

Respectfully returned to Major Kingman, concurring in his recommendations in fifth indorsement hereon, the consideration of the subject, with report thereon, to be in pursuance of section 11 of the river and harbor act of March 3, 1899.

After the matter has been carefully studied and tentative lines drawn upon a convenient map, the whole subject will be considered at a public hearing, previously advertised, at which all the interested parties will be given full opportunity to examine the proposed lines and express their views thereupon.

With his final report on the proposed lines Major Kingman will submit a tracing showing the lines, with proper description, which in his opinion will best subserve the interests involved.

To be returned.

By command of Brig. Gen. Gillespie:

A. MACKENZIE,  
*Colonel, Corps of Engineers.*

[Seventh indorsement.]

ENGINEER OFFICE, U. S. ARMY,  
Cleveland, Ohio, April 8, 1903.

Respectfully returned to the Chief of Engineers with a final report and recommendation of this date.

There is also returned all of the inclosures enumerated in the sixth indorsement, and also all letters which have been received in connection with the subject-matter.

Inclosures 2 and 8 and the tracing<sup>a</sup> showing the harbor line proposed are transmitted in a separate package.

DAN C. KINGMAN,  
*Major, Corps of Engineers.*

---

<sup>a</sup> Not printed.

## REPORT OF MAJ. DAN C. KINGMAN, CORPS OF ENGINEERS.

ENGINEER OFFICE, U. S. ARMY,  
*Cleveland, Ohio, April 8, 1903.*

GENERAL: I have the honor to submit the following report and recommendation in the matter of the change and extension of the harbor line in the harbor of Toledo, Ohio.

This matter originated in a petition of The Edward Ford Plate Glass Company, et al., riparian owners on the right bank of the Maumee River, and also a letter of Mr. S. C. Schenck, of Toledo, Ohio, in regard to the harbor line on the left bank of the river. No accurate map of this portion of the harbor existed upon which the desired lines could be correctly located, and by which they could be properly described. It was therefore necessary to make a new survey of this portion of the river.

This portion of the river is not much used as a harbor, and the matter did not seem to me of sufficient urgency to justify the expenditure necessary for an immediate survey, as it was entirely practicable to make the survey without cost to the United States by taking a little more time and by making use of the permanent force employed in connection with the improvement of Toledo Harbor. Such a survey was accordingly made, proposed lines were laid down upon the map, and a public hearing was arranged for the 10th day of July, 1902, to be held in the city of Toledo, Ohio. A notice of this hearing was sent by mail to all parties interested so far as they were known. A copy of this notice<sup>a</sup> is submitted herewith and is marked "A." In addition, publicity was given by mention in the Toledo newspapers of the time. Clippings<sup>a</sup> from these papers are submitted herewith and are marked "B." The hearing was duly held at the time and place named in the notice. A copy of the minutes<sup>a</sup> of the meeting is transmitted herewith and is marked "C."

It was found at the meeting that while the riparian owners interested in the right bank of the river were generally present, those interested in the left bank failed to appear. The petitioner, Mr. Schenck, submitted a letter<sup>a</sup> (marked "D") in which he stated that he placed his interests in the hands of the Wabash Railroad Company and would take no further action in the matter. No one representing the Wabash Railroad was present at the hearing. I made every effort to find some of the interested parties before closing the hearing but without success. The hearing, however, was no sooner closed when I began to receive letters expressing dissatisfaction with the line proposed for the left bank. These letters<sup>a</sup> are submitted herewith and are marked "E," "F," "G," "H," "I," and "J."

The dissatisfaction with the proposed line was due to the fact that the owners thought it was too close to the river bank, and they desired to have it moved out about 18 or 20 feet farther into the river. There was no objection from the standpoint of the United States to this change, but in order to properly fix the new line surveys were necessary. It seemed to me best to make these surveys and to call another hearing for a final discussion of the matter. The surveys were accordingly made and a description of the line prepared, and a meeting was arranged to be held in the city of Toledo, Ohio, on the 29th day of January, 1903. A copy of the circular<sup>a</sup> notice is transmitted herewith and is marked "K."

---

<sup>a</sup> Not printed.

Additional publicity was also given by newspaper notice. Clippings<sup>a</sup> from the papers are transmitted herewith and are marked "L" and "M."

I took particular pains that all parties at interest should not only be notified of the proposed hearing, but they should acknowledge the receipt of the notice in such way as to make it a matter of record. As far as possible, I had notices personally served upon the parties. In other cases they were mailed with a special request for acknowledgment. Evidence of the receipt of this notice in one form or the other is submitted in Exhibits<sup>a</sup> N, O, P, Q, R, S, T, and "U," and a letter<sup>a</sup> describing the manner of collecting this information is also submitted herewith and marked "V." The hearing was duly held and a copy of the minutes<sup>a</sup> is submitted herewith and marked "W." As a result of this hearing, after carefully considering all the evidence adduced by the hearing and the survey, and by a number of personal examinations, I have the honor to recommend that the following be adopted as the harbor line in this portion of Toledo Harbor:

\* \* \* \* \*

[For description of harbor lines, see separate paper herewith.]

There has been an unavoidable delay in submitting this final report after the last hearing, which has been due to the time required to prepare the tracing. When the tracing was partially completed my draftsman was taken sick and two or three weeks time was lost in consequence. When he had nearly completed the tracing he made a mistake in plotting a portion of the harbor line. An erasure, of course, would not be permissible on a permanent record of this character, and therefore it was necessary to make an entirely new tracing.

Very respectfully, your obedient servant,

DAN C. KINGMAN,  
*Major, Corps of Engineers.*

Brig. Gen. G. L. GILLESPIE,  
*Chief of Engineers, U. S. A.*

#### LETTER OF THE CHIEF OF ENGINEERS.

OFFICE OF THE CHIEF OF ENGINEERS,  
U. S. ARMY,  
*Washington, May 19, 1903.*

SIR: In August, 1901, there was received at the Department a petition signed by The Edward Ford Plate Glass Company and other property owners for a modification of the established harbor line on the right bank of the Maumee River in the upper portion of Toledo Harbor, Ohio.

The matter was referred to the local engineer officer, who reported that before final action should be taken a new examination and survey of the locality should be made, but that the interests involved were not of sufficient importance to demand that a special force be employed for the purpose. With the consent of the leading petitioners, it was proposed to delay action so as to permit the survey to be made by the regular force from time to time, as circumstances would permit.

In the meantime request was made for a change in the line on the left bank at the same place.

---

<sup>a</sup> Not printed.

The matter has now been thoroughly investigated, a survey has been made, and two public hearings have been held. Final report by the local officer, Major Kingman, is herewith, dated April 8, 1903.

Concurring in the views of Major Kingman, I recommend that the modified line proposed by him be approved by the Secretary of War. The lines selected are shown on the accompanying tracing<sup>a</sup> and described in a separate paper.

For the sake of convenience in use, I further recommend that the Secretary place his approval on the description as well as the tracing, both having been prepared for his signature.

Very respectfully, your obedient servant,

G. L. GILLESPIE,  
*Brig. Gen., Chief of Engineers,*  
*U. S. Army.*

Hon. ELIHU ROOT,  
*Secretary of War.*

#### DESCRIPTION OF MODIFIED HARBOR LINES ON MAUMEE RIVER, TOLEDO HARBOR, OHIO.

##### HARBOR LINE ON THE RIGHT BANK.

Beginning at the middle of the top of the stone pier at the angle in Fassett Street Bridge. Point is marked by chiseled lines on axis of bridge and at 90° with it.

Thence runs in a southerly direction at an angle of about 94° 40' with axis of bridge, about 785 feet, parallel to the face of the Chicago, Hamilton and Dayton Railroad iron elevator built in 1901, and 34.5 feet from the finished face of its concrete foundation to a point 241 feet southerly from the intersection of this harbor line with the line of southerly finished face of concrete foundation of elevator. This concrete foundation extends 6.45 feet southerly and 0.14 feet westerly from the walls of the elevator building.

Thence deflecting westerly about 15° 40', about 1,050 feet to a point on the axis of the Brown road or Oakdale avenue, which is distant 375 feet along said axis from a city stone monument situated at or near the intersection of said axis and the westerly line of Miami street. This harbor line produced strikes the southerly face of elevator foundation 33.1 feet (computed) easterly from its southwest corner.

Thence deflecting westerly about 20° 40', about 480 feet to a point believed to be in the prolongation of the property line between Tracy and Barber. Said point is 751 feet on a true azimuth of 204° 49' from triangulation station "Dayton" and 690.1 feet (computed) on a true azimuth of 86° 03' from stone monument on axis of Brown road above described, the monument being 1,240.7 feet (computed) on true azimuth of 234° 00½' from the triangulation station "Dayton." Triangulation station "Dayton" is marked by an iron bar 1½" square by 48" long, projecting 6" above ground, ¼" hole drilled 12" deep and letters U. S. point marked on top. It is situated about 20 feet from the bluff bank in abandoned roadway of Miami street, about 650 feet above the upper end of highway bridge over Chicago, Hamilton and Dayton Railroad tracks, 280 feet above center of city natural-gas gatehouse, 100 feet above west property line of Barber property.

Thence deflecting westerly about 22° 40', about 5,790 feet to a point which is in the prolongation of the westerly face of the brick grinding shed of the Edward Ford Plate Glass Company, at Rossford, and 844.5 feet from its northwest corner. It is 588 feet from triangulation station "Ford," which is situated 4.2 feet west of said prolongation and 256.5 feet from said corner. This triangulation station "Ford" is marked by a bar similar to that at triangulation station "Dayton."

Thence on the same straight line about 920 feet to the westerly property line of the Edward Ford Plate Glass Company.

The last-mentioned line, about 6,710 feet long, is further marked by temporary oak stakes, to be replaced by iron bars, situated one in Walbridge Park, on left bank of river, and one on right bank 154.6 feet below the Brown road monument and 2 feet east of fence along the top of bluff.

<sup>a</sup> Not printed.



## HARBOR LINE ON THE LEFT BANK.

Beginning at the middle of the top of the easterly stone pier of the Fassett Street Bridge, which is about 400 feet from the center of draw. Point is marked by chiseled lines on axis of bridge and  $90^{\circ}$  to it.

Thence it runs in a southerly direction, ranging back to the middle of the face on the new Lake Shore and Michigan Southern Railroad east abutment at its top, and making an angle of about  $77^{\circ} 35'$  with the axis of Fassett Street Bridge west, a distance of 465 feet.

Thence deflecting westerly  $22^{\circ} 48\frac{1}{2}'$  a distance of 369 feet.

Thence deflecting westerly  $22^{\circ} 48\frac{1}{2}'$  toward a point in Maumee avenue (nearly in its axis), which is on the line of two sewer manholes near the axis of that street, 104.4 feet southerly from the most southerly of the two and 13.3 feet southerly from the brick face of sewer outlet, each measured along the line of manholes. This line is nearly parallel to Wabash elevator No. 5, and is 29.5 feet from its southeast corner and 29.2 feet from its southwest corner, the foundation being 0.3 feet outside of the main wall above used. This line ends at a point described as follows: About 4,130 feet from the point of beginning, 352 feet westerly from its intersection with the prolongation of the west main wall of elevator, 176.4 feet easterly from the point in the line of manholes toward which it runs, and 190.2 feet on a true azimuth of  $293^{\circ} 24'$  from the southerly manhole of sewer in Maumee avenue.

Thence deflecting about  $4^{\circ} 47'$  southerly it runs straight, parallel to and distant 581.7 feet from the right of way of the Wabash Railroad, as shown by posts set on its north line between Stocking street and the Toledo waterworks, a distance of about 4,640 feet to a point in the prolongation of the west face of the main building of the Toledo waterworks pumping station, and 585.3 feet from its southwest corner. This line strikes the southwest corner of elevator No. 5, passes 119.6 feet from the southerly manhole in Maumee avenue, and 28.5 feet from the brick face of sewer outlet, each measured along the line of manholes, 34.1 feet south of the southeast corner and 34.3 feet south of the southwest corner of brick engine house in Schenck coal sheds.

The proposed harbor line on left bank from Maumee avenue to waterworks will be at the following distances from the points named:

	Feet.
North line, right of way, Wabash.....	581.7
Southwest corner waterworks pumping station .....	585.3
Outer face waterworks intake (rough) .....	34.1
Nail on face of Clover Leaf wharf.....	32.1
Southwest corner Schenck wharf, new.....	25.1
Southeast corner Schenck wharf, new.....	20.6
Southwest corner Schenck brick engine house.....	34.3
Southeast corner Schenck brick engine house .....	34.1
Brick face sewer outlet, Maumee avenue.....	27.6
Brick face sewer outlet on line Maumee avenue .....	28.5
Timber at sewer outlet, Maumee avenue (rough).....	24.4
Manhole, Maumee avenue (on line of avenue).....	119.6
Manhole, Maumee avenue (perpendicular to line).....	115.7
Southwest corner elevator No. 5 foundation (on line of elevator).....	<sup>a</sup> 0.3
Southwest corner elevator No. 5 wall (on line of elevator) .....	0.0

Line 581.7 strikes main corner of elevator and intersects the Mitchell and Rowland line 352 feet west of west face of elevator.

[First indorsement.]

WAR DEPARTMENT, May 23, 1903.

Approved.

WM. CARY SANGER,  
Assistant Secretary of War.

<sup>a</sup> Controlling element of line.



## APPENDIX S S.

---

### IMPROVEMENT OF ERIE HARBOR, PENNSYLVANIA, AND OF CERTAIN RIVERS AND HARBORS IN WESTERN NEW YORK.

---

REPORT FOR THE FISCAL YEAR ENDING JUNE 30, 1903, WITH OTHER DOCUMENTS RELATING TO THE WORKS. OFFICERS IN CHARGE, MAJ. T. W. SYMONS AND MAJ. THEO. A. BINGHAM, CORPS OF ENGINEERS.

#### IMPROVEMENTS.

- |  |  |
|--|--|
| 1. Erie Harbor, Pennsylvania.  | 5. Buffalo entrance to Erie Basin and Black Rock Harbor, New York. |
| 2. Dunkirk Harbor, New York.   | 6. Tonawanda Harbor and Niagara River, New York.                   |
| 3. Buffalo Harbor, New York.   |  |
| 4. Lake Erie entrance to Black Rock Harbor and Erie Basin, New York. |  |
- 

UNITED STATES ENGINEER OFFICE,  
*Buffalo, N. Y., July 13, 1903.*

GENERAL: I have the honor to forward herewith reports of operations on the river and harbor \* \* \* works under my charge for the year ending June 30, 1903.

Very respectfully, your obedient servant,

THEO. A. BINGHAM,  
*Major, Corps of Engineers.*

Brig. Gen. G. L. GILLESPIE,  
*Chief of Engineers, U. S. A.*

---

## S S 1.

### IMPROVEMENT OF ERIE HARBOR, PENNSYLVANIA.

#### REPORT OF OPERATIONS.

All work was done under contract with the Buffalo Dredging Company, Buffalo, N. Y., dated August 29, 1902.

#### DREDGING.

This item of the contract implied, first, the removal of a shoal at the entrance to the channel east of the north pier; second, the extension of deep water in the harbor basin eastward along the dock fronts, but lakeward from the harbor line, to the extent of the funds estimated as available for this work.

*Channel excavation.*—This work was carried on during favorable weather in connection with the basin work. Operations during 1902 were begun on September 20 and suspended on November 4. During the interval 5,235 cubic yards, scow measure, of fine hard sand were removed from an area approximating 39,700 square feet, restoring a least depth of 20 feet at mean lake level to the entrance channel, except on the north side.

Examination of the dredged areas showed rapid shoaling under the influence of the autumn gales, and work was suspended for the season to avoid redredging the same areas in the spring.

On the resumption of operations in 1903 a survey of the outer bar was made, from which it was decided to dredge the bar over the full width of the channel 300 feet and between 21-foot curves in the lake and channel. The work was done by one dredge between April 21 and 30, 15,500 cubic yards, scow measure, of sand having been removed from an area of 99,390 square feet. The depths on the bar before dredging ranged from 19 feet on the south side to a least depth of 15 feet on the north side of the entrance channel.

*Harbor basin.*—At the contract price, 18½ cents per cubic yard, scow measure, the volume of this item was fixed at 300,000 cubic yards, scow measure, and the area defined as lying to the westward of the line of the west face of the Hard Coal Trestle Wharf and extending from deep water in the channel south to deep water in the area excavated in 1900. For 80 feet in width along the channel the excavation was dredged 280 feet longer to the east. The area dredged was 1,200 feet long, excepting the width of 80 feet, where the excavation was 1,480 feet long and 1,440 feet wide. The prevailing depth at the west end was 20 feet, at the extreme east end 13 feet, before dredging.

The material on the west end was soft mud and slush, graduating to a compact sand in the east end. Work was begun by one dredge September 25, and an additional dredge placed on the work October 2. Both suspended operations for the season December 6. One dredge resumed operations on April 15 and completed the work on June 5. The excavation covered 1,745,000 square feet, from which was removed a total of 286,871 cubic yards, scow measure, of sand and mud.

*Concrete superstructure, south pier.*—This work implies the removal of the decayed timber superstructure and stone filling from the whole pier, 1,217 feet long, to the elevation of 2 and 3 feet below mean water level in different portions of the work, as defined in the specifications; the leveling and repair of the cribs to a true grade at these elevations; the placement of concrete blocks of the dimensions specified, backed with stone filling, and the molding in place of a concrete deck, covering the blocks and stone filling.

Operations were begun by the contractors in October, 1902, when preparations were made for molding concrete blocks at a yard established at the Anchor Line docks. The first block was molded on December 4, 1902, and operations suspended for the season on December 23. A total of 54 blocks were molded in the interval. Operations were renewed on April 13, 1903, and have been carried on without delay, except weather, since then.

The following was the condition of the work at the close of the fiscal year:

The superstructure and crib walls above grade had been removed for a distance 421.7 feet from the east end; 210 feet, seven crib

lengths, from the east end had been leveled and repaired for the reception of concrete blocks; thirty-one side wall blocks had been placed in position and two cross-wall blocks molded in place; the flagstones mentioned in paragraphs 84 and 85 of the specifications had been removed to the south breakwater and deposited in the deck of that structure for a distance of 571 feet from the north end.

*Timber crib jetty.*—One jetty 300 feet long was required to be constructed on the lake shore of Presque Isle Peninsula under contract. The location of this work was fixed at a point on the lake beach approximating  $\square$  52 of the survey of 1896. The work implies the construction and placement of three cribs each 100 feet long and 12 feet wide, the inner crib being  $2\frac{1}{2}$  feet high and sunk in an excavated area in the weather beach. The other cribs conform in height to the bed of the lake and are sunk on a prepared rubblestone foundation where necessary to preserve the planned elevations. The extreme outer end of the work is built in the form of a T, 32 feet long and 10 feet wide. The outer crib is protected by riprap.

A continuous superstructure 3 feet high and decked over with 6-inch plank is built over the cribs. The cribs and superstructure are filled with rubblestone filling. Hemlock timber and plank and wrought-iron screw bolts, drift bolts, and spikes are the construction materials.

Construction of the cribs was begun January 6, 1903, and completed June 3. The excavation for foundation for the shore crib was begun May 21 and completed on the 22d. The cribs were sunk on the following dates: May 22, June 3, and June 5.

The construction of the superstructure was begun at the shore end on June 6, and the jetty was practically completed at the close of the fiscal year.

*Repairs to structures.*—Only minor repairs were made during the year. Two breaches, covering 73 linear feet of the walls of the south breakwater, were closed. Timber and iron removed from the superstructure of the south pier by the contractors were utilized and the work was done by hired labor between May 19 and 26, at an expense for labor of \$37.40.

The care of public property, the surveillance of the peninsula, and the water-level observations with the automatic water gauge were continued during the year.

#### SURVEILLANCE OF PRESQUE ISLE PENINSULA.

Watchman James Hunter was on duty throughout the year to see that no depredations were committed, and to put out fires which occasionally occur. In addition to these duties he acted as engineer of the steam launch during the season of navigation, and since April 15, 1901, has taken charge of the water gauge.

The attempts of past years to secure for private or corporate interests the right to use or title to the peninsula, through enactments in the State legislature (see Annual Report of the Chief of Engineers for 1898, p. 2743 et seq., and for 1901, p. 3298 et seq.), were followed by another bill introduced in the legislature of Pennsylvania in March, 1903, by which the commissioners of waterworks in the city of Erie, Pa., were to be given all of the rights of the State in about 175 acres of land on the peninsula.

It is understood that this movement to get control of the peninsula or a large portion of it meets with no favor among a very large portion of the people of Erie, and a letter of protest was sent by a representative citizen of Erie to the War Department. The following correspondence ensued:

U. S. ENGINEER OFFICE,  
Buffalo, N. Y., March 28, 1903.

Brig. Gen. G. L. GILLESPIE,  
*Chief of Engineers, U. S. Army, Washington, D. C.*

GENERAL: Referring to your indorsement on the letter of John P. Vincent, I have the honor to report as follows:

The commissioners of waterworks of the city of Erie are making an effort to improve the water supply of the city, and for this purpose are desirous of obtaining the right to locate settling basins and filtering beds on the peninsula in the vicinity of the place where the United States has already given them the right to extend their intake pipes.

To this end they have caused a bill to be introduced in the Pennsylvania legislature giving to them all the rights of the State of Pennsylvania in about 175 acres of the peninsula lands (a copy of the bill is herewith). This bill specifically states that "The governor of the State of Pennsylvania be, and he is hereby, authorized and directed to convey to the commissioners of waterworks in the city of Erie, and to their successors, the right, title, and interest of the Commonwealth of Pennsylvania in and to the following-described piece of land," etc. And the bill further states that "All rights hereby granted are subject to the grant heretofore made to the United States by the State of Pennsylvania."

I can see no serious objection to the passage of this bill nor any reason why the United States should attempt to interfere with such passage. The use which the commissioners of Erie propose to make of this piece of land is for the general public interest and will not interfere with any uses that the United States can make of the land, as far as I can see now.

If the bill becomes a law, then it will be proper for the commissioners to apply to the United States for authority to use the land, and at that time any conditions which the United States might deem necessary to impose could be imposed. One of the conditions which should be imposed would be that the grant to the commissioners should not interfere with the passage of any form of highway that might be deemed necessary and proper by the United States from the eastern to the western part of the peninsula across the land granted. It would hardly do to grant this land or privileges on same in such manner as to cut the peninsula in two. As will be noticed in the last paragraph of the bill (which is an amendment of the bill as originally introduced), this feature of the case is provided for by allowing the commissioners to grant any required permits or licenses to the Government, but to nobody else.

While I do not think that the proposed use of a portion of the peninsula need be objected to or the passage of the bill opposed, I think that when it comes to getting the consent of the United States to this use of the area desired another condition which the United States should insist upon would be to have its title to the entire peninsula cleared up and acknowledged. It is the opinion of some eminent lawyers that the United States now has a fee-simple title in the property and that the State of Pennsylvania has no rights to transfer to the water commissioners of Erie or anybody else. This is, however, not clear or settled. On account of this unsatisfactory condition of the title and claims of the State of Pennsylvania there will always in the future, as in the past, be schemes against the peninsula and attempts to get it or parts of it or rights on it by private individuals or corporations or the city of Erie itself. There is no question in my mind that the public interests would be best subserved by the title being completely and unquestionably vested in the United States. If such were the case, I should interpose no objection to the commissioners getting all the rights which they are now asking the State of Pennsylvania for and which they must ultimately ask the Government for. It would be a proper policy, in my opinion, to refuse to grant these rights or to make any further appropriations for Erie Harbor until the title to the peninsula be made indefeasible in the United States, either through the action of the Pennsylvania legislature or by judgment of the courts.

I send a map of Erie Harbor on which has been platted the land which the water commissioners propose to take under the terms of this bill.

Very respectfully, your obedient servant,

T. W. SYMONS,  
*Major, Corps of Engineers.*

Under date of April 10, 1903, the Secretary of War wrote to the governor of Pennsylvania requesting that he recommend to the general assembly of the State the passage of an act confirming and vesting in the United States a complete and indefeasible title to Presque Isle Peninsula, as follows:

WAR DEPARTMENT,  
Washington, April 10, 1903.

SIR: The attention of the War Department has been called to the fact that a bill has been introduced in the legislature of the State of Pennsylvania, giving to the commissioners of waterworks of the city of Erie all the rights of the State of Pennsylvania in about 175 acres of land on the peninsula of Presque Isle, in Erie Harbor.

The Federal Government has possession of the property, but it seems to be conceded by the law officers of the United States that the title held by the Government is not a complete and indefeasible one.

Repeated efforts have been made by the city of Erie to get possession of this property, numerous applications having been made to the War Department for permits involving the use of the property in one way or another, and a bill was passed by the State legislature in 1897 having this object in view, but was vetoed by the governor at the instance of the Secretary of War. Another bill was introduced in 1901, which also failed to become a law.

It appears that the preservation of this peninsula is in the highest degree important for the protection of Erie Harbor and that it is very desirable that it should remain entirely under the control of the Federal Government. Under date of April 4, 1901, the Department addressed a letter to Governor Stone on the subject (copy herewith), in which a full history of the case is given, but he declined to take the action requested.

It is the desire of the War Department that you use your good offices to secure the passage of an act by the general assembly confirming and vesting in the United States a complete and indefeasible title to the said peninsula; or, if you do not see your way clear to do this, to refuse favorable consideration to any legislation which will in any way tend to weaken or destroy the title which the Government already has in the premises.

Very respectfully,

ELIHU ROOT, *Secretary of War.*

HON. SAMUEL W. PENNYPACKER,  
*Governor of Pennsylvania, Harrisburg, Pa.*

This elicited the following reply from the governor:

COMMONWEALTH OF PENNSYLVANIA, EXECUTIVE CHAMBER,  
Harrisburg, April 13, 1903.

HON. ELIHU ROOT,  
*Secretary of War, Washington, D. C.*

DEAR SIR: I beg to acknowledge receipt of your letter of 10th instant, relative to the 175 acres of land on the peninsula of Presque Isle, in Erie Harbor.

This matter will have my careful consideration when the bill comes before me.

Very truly, yours,

SAML. W. PENNYPACKER.

The bill, file of the senate (Pennsylvania) No. 351—1903, was passed and approved by the governor.

Simultaneously with the application to the State, as above noted, the commissioners of waterworks of Erie submitted to the Secretary of War for his examination and approval plans and specifications for the extension of their intake pipe to and across Presque Isle, under authority of an act of Congress approved February 23, 1893, and also applied for permission to use the portion of Presque Isle designated upon a map submitted and identical with the tract of 175 acres involved in the State legislation act heretofore mentioned, "For settling basins and other purposes in connection with the object of improving the water supply of the city of Erie, Pa. \* \* \*"

Under date of May 11, 1903, the Secretary of War approved the plans and specifications and further offered "to the said commissioners of waterworks, under authority of the act of Congress of July 28, 1892 (27 Stats., 321), a lease, revocable at will by the Secretary of War, for the term of two years from the date hereof \* \* \*, of that portion of Presque Isle inclosed in heavy black lines on the attached drawing \* \* \*."

This permission and lease contained conditions which the water commissioners of Erie declined to accept, in a letter to the Secretary of War dated June 17, 1903. This letter was referred, through the Chief of Engineers, to the district office for report and was returned with report, as follows:

BUFFALO, N. Y., July 3, 1903.

Brig. Gen. G. L. GILLESPIE,  
*Chief of Engineers, U. S. Army, Washington, D. C.*

GENERAL: I have the honor to report as follows in the matter of the petition of the water commissioners of Erie:

In their original petition, dated April 20, 1903, to the Secretary of War, the Erie water commissioners apply "for permission to use a portion of the peninsula of Presque Isle, in Erie County, Pa., for the purpose of improving the water supply of the city of Erie by extending the intake pipe of the waterworks of said city across said peninsula and about 1 mile into Lake Erie, and to excavate basins on both sides of the line of said intake pipe for the purposes of sedimentation; and to approve the plans and specifications for said improvement \* \* \* in pursuance of an act of Congress approved February 23, 1893, \* \* \*."

In the fourth indorsement on that petition, under date of May 8, 1903, the Judge-Advocate-General states his opinion as follows: "All this language (of the act of February 23, 1893) is understood to have reference to the extension, protection, and maintenance of the intake pipe, and can not be construed to authorize the use of land for settling basins."

In this letter the water commissioners state, "We do not expect to do any work upon the peninsula for two years. Our work for the next two years will be laying pipe in the harbor and in the lake; after that is finished we hope to construct the basins and do such other work on the peninsula as may be necessary for our purpose."

The act of February 23, 1893, grants to the water commissioners the rights and privileges to do all of the work they propose to do during the next two years. It would therefore appear unnecessary to grant a lease of lands on the peninsula covering that period, and it would further appear that the water commissioners have ample time to obtain through Congress an amendment to the act of February 23, 1893, or a new act, conveying to them the right to construct basins on both sides of the line of their proposed intake pipe for the purposes of sedimentation.

I am therefore of the opinion that the Secretary of War can, consistent with the foregoing facts, withdraw the proffered lease and fully meet the needs of the water commissioners without interfering with the desired improvement of the water supply of the city of Erie, by approving the plans for the water-pipe extension as submitted by the water commissioners, except the plans for settling basins as shown on their blue print.

As shown in the accompanying papers, the water commissioners were to receive bids, June 27, 1903, for the purchase and laying of 2,800 feet of water pipe in extension of their present pipe in Erie Harbor from their present intake crib to the south shore of the peninsula. This work is specified to be done by December 31, 1903, and is all of the work proposed for this year.

Very respectfully, your obedient servant,

THEO. A. BINGHAM,  
*Major, Corps of Engineers.*

No further action in the matter has as yet been taken.

It is believed to be highly desirable that the Government title to the peninsula be cleared of all clouds or deficiencies, and that further improvement of Erie Harbor and the protection of Presque Isle Peninsula should be dependent upon the granting of such title by the State of Pennsylvania.



## CONDITION OF THE WORKS.

The north pier is in good condition, except 750 linear feet of timber crib pier which was built prior to 1883. This portion is badly decayed, and the reconstruction of the superstructure with concrete is urgent.

The reconstruction and repair work now in progress on the south pier and south breakwater will place those structures in good condition, and the dredging done during the fiscal year has placed the channels and basins in good condition, as noted under "Operations."

The preservation of the peninsula is of vital importance to Erie Harbor, and it is for the purpose of preserving the harbor that the protection of the weak parts of the peninsula has been deemed necessary. The weakest portion is the long narrow neck at the western end, and works of protection have been constructed to prevent a breach through this narrow neck. The danger exists during severe storms from the westward.

The protection works for the neck consist of the remains of a shore protection, constructed in 1889, which afford little or no protection, and the tree growth propagated and maintained on the neck. During 1896-1898 about 6,600 young locust and willow trees were planted on the neck of the peninsula. Most of these have grown finely and, it is believed, will furnish a permanent and living protection to this neck.

The beach erosion along the body of the peninsula has been corrected to some extent by jetties built out from the shore. At the present time there is one dilapidated jetty at the easterly end, no longer of service; two jetties about the middle of the peninsula shore, and one westerly therefrom, being constructed under the existing contract and to be completed in 1903.

## PROPOSED OPERATIONS AND REMARKS.

The river and harbor act of March 3, 1899, officially adopts a new and extended project for the improvement of Erie Harbor. This is in accordance with the report from this office, with map, in House Executive Document No. 70, Fifty-fifth Congress, first session, and without map in the Report of the Chief of Engineers for 1897, page 3238. This new project is summarized as follows:

- (1) To repair and keep in repair existing structures.
- (2) To extend the north pier 500 feet.
- (3) To extend the south pier 1,000 feet.
- (4) To dredge the entrance channel to a depth of 20 feet.
- (5) To dredge a portion of the eastern end of the bay, needed for access to docks, to a depth of 20 feet.
- (6) To build four protection jetties along the outside of Presque Isle Peninsula.
- (7) To maintain existing structures and care for Presque Isle Peninsula.

The estimated cost of the project is \$377,000, which, however, does not include item 1, except as specially estimated for at the time the project was adopted.

It is estimated that \$127,000 can be profitably expended during the next fiscal year in carrying on work under the project, viz: To extend the south pier 1,000 feet, to build two protection jetties on the outside of Presque Isle Peninsula, and to complete the dredging of the harbor basin under the project.

## 2122 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

There will be required, in addition, the sum of \$50,000 for new superstructure on the 750 feet of badly decayed pier, and \$10,000 for general maintenance; total, \$60,000; making the total amount that should be appropriated \$187,000.

The business of Erie Harbor is increasing, and this is believed to be largely due to the bettered conditions of the harbor and entrance. The further work covered by the existing project at Erie should be carried on with as little delay as practicable.

*Money statement.*

July 1, 1902, balance unexpended .....	\$143,858.51
June 30, 1903, amount expended during fiscal year .....	54,241.67
July 1, 1903, balance unexpended .....	89,616.84
July 1, 1903, amount covered by uncompleted contracts .....	65,294.36
Amount (estimated) required for completion of existing project .....	127,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1905, in addition to the balance unexpended July 1, 1903:	
For works of improvement.....	\$127,000.00
For maintenance of improvement .....	60,000.00
	187,000.00
Submitted in compliance with requirements of sundry civil act of June 4, 1897, and of section 7 of the river and harbor act of 1899.	

## STATEMENT OF APPROPRIATIONS AND ALLOTMENTS.

1823 .....	\$150.00	March 3, 1871 .....	\$29,000.00
May 26, 1824 .....	20,000.00	1871 (allotment) .....	10,000.00
May 25, 1826 .....	7,000.00	June 10, 1872 .....	15,000.00
March 2, 1827 .....	2,000.00	June 23, 1874 .....	20,000.00
May 19, 1828 .....	6,223.18	March 3, 1875 .....	80,000.00
March 3, 1829 .....	7,390.25	August 14, 1876 .....	40,000.00
March 2, 1831 .....	1,700.00	June 16, 1878 .....	25,000.00
July 3, 1832 .....	4,500.00	March 3, 1879 .....	25,000.00
March 2, 1833 .....	6,000.00	June 14, 1880 .....	25,000.00
June 28, 1834 .....	23,045.00	March 3, 1881 .....	20,000.00
March 3, 1835 .....	5,000.00	August 2, 1882 .....	20,000.00
July 2, 1836 .....	15,122.80	July 5, 1884 .....	50,000.00
March 3, 1837 .....	15,000.00	August 5, 1886 .....	37,500.00
July 7, 1838 .....	30,000.00	August 11, 1888 .....	83,000.00
June 11, 1844 .....	40,000.00	September 19, 1890 .....	40,000.00
August 30, 1852 .....	30,000.00	1891 (received from sales) ..	4,716.89
1864 (allotment) .....	15,000.00	July 13, 1892 .....	40,000.00
June 23, 1866 .....	36,961.00	August 18, 1894 .....	10,000.00
March 2, 1867 .....	25,000.00	March 3, 1899 .....	125,000.00
1868 (allotment) .....	40,000.00	June 13, 1902 .....	125,000.00
1869 (allotment) .....	22,275.00		
June 11, 1870 .....	20,000.00	Total .....	1,196,584.12

## CONTRACTS IN FORCE.

*Contract for dredging and construction at Erie Harbor, Pennsylvania, dated August 29, 1902.*

Name of contractor: Buffalo Dredging Company.

Rates: Dredging, per cubic yard, 18½ cents.

Concrete superstructure, south pier.—Removing old superstructure, per linear foot, \$6.25; new hemlock timber superstructure, per 1,000 feet B. M., \$70; white-oak piles in place, per pile, \$9; stone filling in superstructure, per cubic yard, \$2; concrete blocks, per cubic yard, \$11.75; mass concrete, per cubic yard, \$9.25; manhole covers, each \$6; mooring rings, each \$50.

*North pier.*—Riprap stone in place, per cubic yard, \$3.

*Timber crib jetty.*—Excavation for foundation, per cubic yard, \$1; riprap stone in place, per cubic yard, \$3.25; foundation and filling stone in place, per cubic yard, \$2; hemlock timber in place, per 1,000 feet B. M., \$40; screw bolts in place, per pound, \$0.05; drift bolts, in place, per pound, \$0.04.

Date of approval: September 17, 1902.

Date of beginning of work: September 20, 1902.

Date of expiration: November 30, 1903.

## COMMERCIAL STATISTICS.

*Arrivals and departures of vessels for the year ending December 31, 1902.*

Vessels.	Arrivals from—				Departures to—			
	Home ports.		Foreign ports.		Home ports.		Foreign ports.	
	No.	Tons.	No.	Tons.	No.	Tons.	No.	Tons.
Steam.....	1,212	1,810,618	48	20,986	1,214	1,801,182	33	6,886
Sail and barge.....	106	101,246	38	10,322	108	97,680	50	24,912
Total.....	1,318	1,911,864	86	31,258	1,322	1,898,812	83	31,800

Total arrivals and departures: Number, 2,809; tonnage, 3,873,734.

Increase of tonnage, 1902 over 1901, 669,411 tons.

Amount of revenue collected, year 1902, lake commerce, \$14,817.81.

Value of imports, lake, \$108,876; rail, \$301,771.

Value of exports, lake, \$41,165; rail, none.

Enrolled tonnage, port of Erie, Pa., 42,111 gross tons.

Greatest draft of vessels, 18½ feet.

*Receipts and shipments by lake.*

## RECEIPTS.

[Tons of 2,000 pounds.]

	1897.	1898.	1899.	1900.	1901.	1902.
Merchandise.....	228,388	95,661	123,262	40,376	42,020	78,842
Barley.....	10,617	9,223	2,119		225	2,277
Corn.....	260,290	288,400	147,831	235,940	840	841
Oats.....	5,968	5,916	2,675			
Rye.....	22,041	57,881	10,417			
Wheat.....	154,208	94,862	15,237	39,521	50,146	44,162
Flaxseed.....	13,330	2,224	23,475	9,622	9,785	
Flour.....	199,798	154,614	192,324	104,757	118,776	180,962
Lumber.....	18,886	7,544	18,539	14,306	15,740	23,085
Laths.....	715		63		225	77
Shingles.....	144					
Poles and stave bolts.....			520			
Ties.....	526					
Iron ore.....	1,442,756	1,221,488	1,467,204	1,670,465	1,518,099	1,984,933
Pig iron.....	11,085					
Copper.....	36,751	26,574	29,241	16,267	18,104	5,465
Lead.....	15,212	948	8,865	508	1,170	2,239
Limestone.....			26,812			
Plaster and cement.....	1,331		700			
Scrap iron and steel.....						
Fish.....					8,300	
Pulp wood.....			14,684	40,431	22,618	32,400
Total.....	2,422,041	1,965,330	2,073,868	2,172,193	1,806,048	2,304,803

## SHIPMENTS.

	1897.	1898.	1899.	1900.	1901.	1902.
Anthracite coal.....	515,801	612,282	787,719	725,101	519,974	154,432
Bituminous coal.....	234,432	357,870	537,600	405,741	530,738	660,202
Pig and manufactured iron.....		626	113	416	88	1,079
Merchandise.....	123,677	125,218	187,171	58,905	59,475	105,447
Total.....	873,910	1,096,996	1,412,603	1,186,163	1,110,226	921,160

## S S 2.

## IMPROVEMENT OF HARBOR AT DUNKIRK, NEW YORK.

## REPORT OF OPERATIONS.

The lake faces of several timber cribs of the west pier were washed away by storms in 1900, making two breaches, 30 and 60 feet long, respectively. These breaches were in the two remaining timber portions of the pier, beginning at stations 5+30 and station 8+20, measured from the shore end of the concrete portion of the pier.

The breaches were closed by sinking cribs 29 feet by 9 feet by 7 feet high and 56 feet by 8 feet by 8 feet high to replace the damaged parts of the crib work and rebuilding the timber superstructure over them. This work was begun August 4 and completed October 20, 1902.

On the breakwater 365 linear feet of badly decayed deck, stringers, and plank near the west end of the main breakwater were rebuilt with new hemlock.

This work was done between October 1 and 20. The cost of the repairs on both structures was \$2,582.25 for materials and labor.

## CONDITION OF THE WORKS.

The west pier is in good condition, except two old timber sections, one 110 feet long and one 266 feet long, which are in need of new concrete superstructure. When this new superstructure is supplied the whole pier will be completed in a permanent concrete form.

The breakwater is intact, but the old part, 1,341 feet long, is much decayed, and further patching up of the old timber superstructure is not effective or advisable. It should be replaced by concrete in the near future.

## PROPOSED OPERATIONS AND REMARKS.

The work outlined in the adopted project for Dunkirk Harbor has been completed and the harbor is ready for use. Experience has demonstrated that the addition of an easterly breakwater is necessary to properly protect the harbor, and a report with estimates of the cost of the requisite structure was submitted and published in House Document No. 74, Fifty-sixth Congress, first session.

All of the timber portion of the main breakwater built prior to 1880, 1,341 linear feet, is old and much decayed and liable to be seriously damaged by seas, necessitating extensive repairs. The remaining timber portions of the west pier, viz, two sections, one 110 feet long and one 266 feet long, at the outer end, are also old and much decayed and liable to similar damage.

The thorough repair of these structures can only be affected by rebuilding the superstructures in concrete, and this plan has been followed out so far as funds would permit during the past five years.

The repair work on the west pier substructure, closing the breaches therein, was done with a view to preparing the substructure to receive a new concrete superstructure. This concrete work could not be done until the new repair cribs had fully settled upon their foundations. Such final settlement has now occurred but the available funds are not sufficient for replacing the 376 linear feet of old timber work with a



THE  
JOURNAL OF THE  
ROYAL ANTHROPOLOGICAL INSTITUTE

Volume 100, Part 1  
1970



concrete superstructure, which is estimated to cost \$25,000, including contingencies and engineering expenses.

Moreover, the pier work could be most advantageously done in connection with at least as much again of concrete work on the breakwater, or under a contract of not less than \$50,000. It is therefore estimated that the next river and harbor bill should appropriate \$35,000, to be used in connection with the funds available for completing the concrete superstructure on the west pier, which is estimated to cost \$25,000; for rebuilding with concrete 500 linear feet of decayed superstructure on the breakwater, which is estimated to cost \$25,000, including contingencies, and for general maintenance of structures and channels, which is estimated at \$7,000, including contingencies.

*Money statement.*

July 1, 1902, balance unexpended .....	\$26, 620. 36
June 30, 1903, amount expended during fiscal year .....	4, 588. 33
July 1, 1903, balance unexpended .....	22, 032. 03
<hr/>	
{ Amount that can be profitably expended in fiscal year ending June 30, 1905, for maintenance of improvement, in addition to the balance unexpended July 1, 1903 .....	
{ Submitted in compliance with requirements of sundry civil act of June 4, 1897, and of section 7 of the river and harbor act of 1899.	
	35, 000. 00

STATEMENT OF APPROPRIATIONS AND ALLOTMENTS.

March 27, 1827 .....	\$3, 000. 00	March 3, 1873 .....	\$48, 132. 96
May 19, 1828 .....	6, 000. 00	June 23, 1874 .....	35, 000. 00
March 3, 1829 .....	9, 812. 75	March 3, 1875 .....	35, 000. 00
April 23, 1830 .....	1, 342. 75	August 14, 1876 .....	18, 000. 00
March 2, 1831 .....	7, 102. 50	1879 .....	2, 500. 00
July 3, 1832 .....	10, 200. 00	June 14, 1880 .....	10, 000. 00
June 28, 1834 .....	4, 000. 00	July 5, 1884 .....	10, 000. 00
March 3, 1835 .....	10, 988. 43	August 5, 1886 .....	20, 000. 00
July 2, 1836 .....	11, 000. 00	August 11, 1888 .....	15, 000. 00
March 3, 1837 .....	15, 000. 00	September 19, 1890 .....	20, 000. 00
July 7, 1838 .....	10, 000. 00	July 13, 1892 .....	20, 000. 00
June 11, 1844 .....	5, 000. 00	August 18, 1894 .....	20, 000. 00
August 30, 1852 .....	30, 000. 00	June 3, 1896 .....	10, 000. 00
March 2, 1867 .....	100, 000. 00	June 22, 1896, repayment .....	250. 00
1869 .....	2, 000. 00	June 4, 1897 .....	\$98, 258. 00
July 11, 1870 .....	25, 000. 00	June 13, 1902 .....	25, 000. 00
March 3, 1871 .....	25, 000. 00		
June 10, 1872 .....	25, 000. 00	Total .....	987, 587. 38

COMMERCIAL STATISTICS.

*Arrivals and departures of vessels for the year ending December 31, 1902.*

Vessels.	Arrivals from—				Departures to—			
	Home ports.		Foreign ports.		Home ports.		Foreign ports.	
	No.	Tons.	No.	Tons.	No.	Tons.	No.	Tons.
Steam .....	71	16, 149	1	24	68	16, 108	1	24
Sail and barge .....	1	565			1	565		
Total .....	72	16, 714	1	24	69	16, 673	1	24

Total arrivals and departures, 143; tonnage, 33,435.  
 Decrease of tonnage, 1902 under 1901, 15,713 tons.  
 Amount of revenue collected for the year 1902: Lake, none; rail, \$1,457.40.  
 Value of imports: Lake, none; rail, \$11,207.  
 Value of exports, none.  
 Receipts by lake: Lumber, 3,684 tons; miscellaneous freight, 58 tons; total, 3,742 tons.  
 Shipments by lake, none.  
 Passengers entered and departed, about 16,000.  
 Enrolled tonnage, port of Dunkirk, N. Y., 164 gross tons.  
 Greatest draft of vessels, 16 feet.

---

### SS 3.

#### IMPROVEMENT OF BUFFALO HARBOR, NEW YORK.

##### REPORT OF OPERATIONS.

The following is a detailed report of the operations on the different works during the year:

##### EXTENSION OF BREAKWATER TO STONY POINT.

*Rubble mound or stone breakwater.*—Construction under existing contracts was continued through the fiscal year, except during the winter months, January to April.

For the convenience of keeping track of all operations connected with the construction of the stone breakwater it is divided into seven sections, six of which are each 1,000 feet in length and one is 1,250 feet long. The northern section is No. 1, and the most southerly is No. 7. At the beginning of the fiscal year, July 1, 1902, sections 1, 2, 3, and 4 were completed; section 5 completed except part of the top angle stones; section 6 about one-half done, and section 7 well started.

The total expenditure at this date was \$752,611.78.

The prevailing winds for the first four weeks in July, 1902, were from the southwest. They were generally light except about the middle of the month, when some high winds occurred which somewhat retarded the progress of the work. The end of the month was quite calm. These conditions allowed the placing of 16,815.4 tons of capping stone during the month.

For the month of August, 1902, the weather conditions were extremely good. The winds were about equally divided between westerly and easterly, with but few high seas. Under these favorable conditions 17,237.5 tons of capping stone were placed, which is the maximum amount for any month to date, 105 stones, or 663 tons, being placed for each working day. Four large floating derricks were engaged in the work.

High westerly winds occurred during the first half of September, 1902, while easterly winds predominated during the latter part of the month. The former winds interfered materially with the progress of the work, so that but 12,608.3 tons of capping stone were placed during the month, being but three-fourths of the quantity placed in August.



High westerly winds with high attending seas retarded the progress of the work during October, 1902, the amount of capping stone placed being but 9,887.2 tons, or a little more than one-half of that placed during August.

Favorable progress was made during November, 1902, high winds occurring on comparatively few days, which is unusual at this time of the year at the east end of Lake Erie. During the month 10,638.6 tons of capping stone were placed.

As the working season for 1902 was rapidly approaching an end, the contractors, Hughes Bros. & Bangs, were making strenuous efforts to complete the stone breakwater early in December, but a few days' more work being required to do this when, on December 10, 1902, a violent storm from the southwest occurred. The maximum velocity of the wind was 58 miles per hour at noon of this day. Between the hours of 9 a. m. and 2 p. m. the hourly velocity ranged from 46 to 56 miles. During the prevalence of this storm a length of about 1,000 feet of the breakwater settled to water surface. Five days later, on December 15, 1902, 800 feet more, to the south, went down to water surface. The settlement commenced at 5,900 feet from the north end of the breakwater and extended about 1,300 feet south, almost to the timber crib portion of the breakwater. The main portion standing has been completed from one to five years and has had such tests during violent storms as to indicate its permanent stability. The portion that settled was built during the season of 1902. The inference is that the soft clay bottom at the settled portion has less bearing power than the bottom has to the north, where the structure has stood without any settlement. This inference is strengthened by the fact that the borings taken before the breakwater was built show that the clay beneath the standing part has strata of sand, hard sand, gravel, hard gravel, etc., running through it. These strata are entirely absent in the clay bottom beneath the settled part of the breakwater, where the borings show soft red clay and very soft red clay only.

The settlement was a peculiar one, as only the rear portion settled, leaving the front or lake side from the water line lakeward in place and apparently undisturbed. The break occurred at the lake-side water line, the high superstructure and all the landward portion settling on a very slight angle from the vertical about to the water level, some portions being a little above and other portions a little below water. The movement was apparently a settling and sliding landward under the pounding of the terrific seas.

As previously stated, the breakwater was nearly completed at the time the settlement took place, and the following statement shows the quantities placed and the cost of the work to December 14, 1902, or up to the time of the settlement:

245,242 cubic yards of gravel, at 13 cents .....	\$31,881.46
202,969.3 tons of rubblestone from the United States, at 80 cents .....	162,375.44
422.1 tonr of rubblestone from the United States, at 77½ cents .....	327.13
317,606.9 tons of rubblestone from Canada, at 80 cents .....	254,085.52
16,315.5 tons of rubblestone from Canada, at 77½ cents .....	12,644.51
129,921.9 tons of rubblestone from Canada, at 75 cents .....	97,441.43
563.5 tons of rubblestone from Canada, at 72½ cents .....	408.54
142,429.1 tons of capping stone from Canada, at \$1.25 .....	178,036.38
142,449.4 tons of capping stone from Canada, at \$1.20 .....	170,939.28
<b>Total cost .....</b>	<b>908,139.69</b>

2128 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

The length of the stone breakwater is 7,250 feet, which makes the cost per linear foot as follows:

Gravel hearthing .....	\$4. 40
Rubblestone facing and filling .....	72. 73
Revetment and capping stone .....	48. 13
<b>Total .....</b>	<b>125. 26</b>

This is exclusive of superintendence.

In order to make the necessary repairs to restore the superstructure of the sunken breakwater, a supplemental contract was entered into with the contractors, Hughes Bros. & Bangs, under date of December 31, 1902. Under this supplemental contract the contractors are to—

(1) Take up, store, and reset all the capping stone that can be economically saved and arrange the settled portion under water properly as a foundation for a new superstructure. For this work they are to receive their actual force account plus 15 per cent and also a fair rental for the derrick boats, scows, tugs, etc., employed in the work.

(2) To furnish and place all additional rubblestone required at the original contract price of 80 cents per ton.

(3) To furnish and place all additional capping stone required at the original price of \$1.25 per ton.

As Lake Erie is frozen up during the winter months, nothing could be done on the reconstruction of the breakwater until April 23, 1903, on which date the contractors began active operations, beginning with the recovery of the sunken capping stone by means of a diver. This work of recovery was still in progress at the close of the fiscal year. As fast as recovered the capping stones are stored on the completed part of the breakwater, to be available when needed.

The work of rebuilding the structure and resetting the recovered capping stone was commenced on May 20, 1903, and at the close of the fiscal year about 5,000 tons of the recovered capping stone had been reset.

The first load of new capping stone from the Canadian quarry at Windmill Point, Ontario, was received on June 11, and the work of setting was commenced on June 12. During the month of June 2,203.7 tons of new capping stone was placed. The first scow load of rubblestone for the season was deposited on April 30, 1903.

The following table shows the quantities of revetment and capping stone placed in the work during 1902:

Season of 1902.	Working days.	Revetment and capping stone placed.				Average weight of stone.	Maximum weight of stone.
		Tons of 2,000 pounds.		Number.			
		Total.	Daily.	Total.	Daily.		
April .....	15	1,998.9	132.9	387	26	<i>Tons.</i> 5.16	<i>Tons.</i> 10.3
May .....	27	7,380.2	273.4	1,242	46	5.94	15.0
June .....	25	13,568.6	542.7	2,176	87	6.24	17.5
July .....	26	16,815.4	646.7	2,590	100	6.49	17.5
August .....	26	17,237.5	662.9	2,736	105	6.30	17.5
September .....	25	12,608.3	504.3	2,048	82	6.16	18.0
October .....	29	9,887.2	340.9	1,649	57	6.00	17.8
November .....	28	10,638.6	379.9	1,943	69	5.47	16.7
December .....	11	3,341.2	308.7	681	62	4.90	13.5
Totals and averages .....	212	93,470.9	440.9	15,462	73	6.05	18.0

The following is a summary of the material placed in the stone breakwater during the fiscal year ending June 30, 1903:

*Rubblestone.*

United States (from line of Erie Canal):

Original contract .....	13, 184. 6 tons, at \$0. 80 ...	\$10, 547. 68
Supplemental contract .....	422. 1 tons, at \$0. 77½...	327. 13

Total from United States ..... 13, 606. 7 tons.

Canada (from Windmill Point, Ontario):

Original contract .....	32, 218. 7 tons, at \$0. 80 ...	25, 774. 96
Supplemental contract .....	13, 472. 5 tons, at \$0. 80 ...	10, 778. 00
Supplemental contract .....	16, 315. 5 tons, at \$0. 77½...	12, 644. 51
Supplemental contract .....	23, 885. 8 tons, at \$0. 75 ...	17, 914. 35
Supplemental contract .....	563. 5 tons, at \$0. 72½...	408. 54

Total from Canada ..... 86, 456. 0 tons.

*Capping stone.*

Canada (from Windmill Point, Ontario):

Original contract .....	65, 539. 1 tons, at \$1. 25...	81, 923. 89
Supplemental contract .....	4, 989. 1 tons, at \$1. 20...	5, 986. 92
Supplemental contract .....	2, 203. 7 tons, at \$1. 25...	2, 754. 63

Total ..... 72, 731. 9

Recovered and reset on settled portion..... 9, 603. 60

Total..... 178, 664. 21

At the end of the fiscal year, June 30, 1903, the following material had been placed in the stone breakwater:

245,242 cubic yards gravel from United States, at \$0.13 .....	\$31, 881. 46
202, 969. 3 tons rubblestone from United States, at \$0.80 .....	162, 375. 44
422.1 tons rubblestone from United States, at \$0.77½ <sup>a</sup> .....	327. 13
317, 606. 9 tons rubblestone from Canada, at \$0.80 .....	254, 085. 52
13, 472. 5 tons rubblestone from Canada, at \$0.80 <sup>a</sup> .....	10, 778. 00
16, 315. 5 tons rubblestone from Canada, at \$0.77½ <sup>a</sup> .....	12, 644. 53
129, 921. 9 tons rubblestone from Canada, at \$0.75 <sup>a</sup> .....	97, 441. 43
563. 5 tons rubblestone from Canada, at \$0.72½ <sup>a</sup> .....	408. 54
142, 429. 1 tons capping stone from Canada, at \$1.25 .....	178, 036. 38
2, 203. 7 tons capping stone from Canada, at \$1.25 <sup>a</sup> .....	2, 754. 63
142, 449. 4 tons capping stone from Canada, at \$1.20 .....	170, 939. 28
Capping stone recovered and reset on settled portion <sup>a</sup> .....	9, 603. 60

Total..... 931, 275. 94

At the close of the fiscal year the condition of the stone breakwater was as follows:

- Section 1, stations 0-10, completed.
- Section 2, stations 10-20, completed.
- Section 3, stations 20-30, completed.
- Section 4, stations 30-40, completed.
- Section 5, stations 40-50, completed.
- Section 6, stations 50-60, completed.

Section 7, stations 60-72+50. This is the settled portion being rebuilt. For a length of 800 feet the structure had been rebuilt 2 to 12 feet above water level, and for the remaining length of 461 feet the settled work had been leveled for rebuilding at generally 2 feet below water level.

*Windmill Point, Ontario, quarry.*—As in previous seasons, the major portion of the rubblestone and all of the revetment and capping stone used in the breakwater extension to Stony Point during the fiscal

<sup>a</sup> Supplemental contracts.

year came from the Canadian quarry of the contractors, Hughes Bros. & Bangs, located at Windmill Point, Ontario, about 6 miles west of Buffalo, N. Y. The formation of the land at the quarry site and vicinity is almost level, the stone being quarried from below the surface of the ground. The earth stripping over the rock is but a few feet in thickness. At present the quarry consists of an oblong excavation about 10 acres in extent and averaging about 28 feet in depth, the workings being carried on on the north face.

The stone is limestone, gray in color, the formation being known as the Onondaga or Corniferous (Upper Helderberg).

Below are given a few analyses of the stone:

[Per cent.]

No.	Moisture.	Silica.	Iron and alumina.	Calcium carbonate.	Magnesia.	Phosphoric acid.
1	0.226	30.15	1.03	66.84	1.29	0.021
2	.29	30.34	1.27	65.06	2.80	.025
3	.36	45.30	.94	50.29	.86	.16
1c	.20	21.83	.99	72.52	1.39	.009

At the beginning of the fiscal year, July 1, 1902, an average force of about 250 men was employed. Of this force about 100 are classed as laborers, the remainder comprising superintendents, timekeepers, foremen, drill runners and helpers, engine drivers, and mechanics of various classes.

The plant employed in the quarrying of the stone during the season of 1902 was a very extensive one, and comprised 40 steam drills, 18 large hoisting engines, operated by steam power and capable of handling loads of 20 tons, eight 50-horsepower boilers, 11 hoisting engines, 2 locomotives, about 100 cars used for the transportation of rubble and capping stone from the quarry to the loading dock, besides small engines and pumps of various kinds. There was also a blacksmith shop complete with 10 fires, operated by 10 blacksmiths, assisted by 9 helpers.

During the season of 1902 there were quarried 230,750.1 tons of stone of all classes, over 5,000 pounds of dynamite and over 40,000 pounds of powder being used in their manufacture. This would indicate the use of 1 pound of dynamite for every 42 tons of stone, and 1 pound of powder for every 5 tons of stone gotten out.

Owing to the virtual completion of the stone breakwater, the contractors partly dismantled the plant at the quarry during the winter of 1902-3, and shipped the same to points in Ohio for use on the Cleveland breakwater for which the same firm are the contractors.

Operations in the quarry were resumed on April 22, 1903, being stripping work preparatory to quarrying stone. The actual work of quarrying this needed stone was commenced on April 27, 1903, and has progressed satisfactorily up to date. At the time of the resumption of work the force consisted of 75 men, of which about 50 are classed as laborers, the remainder being artisans more or less skilled. By June 1, 1903, this force was increased to 112 men, consisting of 1 superintendent, 1 timekeeper, 1 general foreman, 11 foremen, 9 drill runners and assistants, 6 hoist enginemen, 61 laborers, and 13 mechanics. The plant consisted of 9 steam drills, 9 large hoisting derricks,

4 stationary 50-horsepower boilers, 6 hoisting engines, 2 steam pumps, 1 locomotive, and 49 cars used for the transportation of stone. In addition there is a large mileage of railway tracks, quarters for men, blacksmith shop, office, magazine for the storage of explosives, loading dock, and many adjuncts.

Some delay in shipping stone from this quarry was caused by the sinking of the schooner *Bahama* alongside the loading dock on June 3, 1903. This schooner was one of the two used for the transportation of stone to the breakwater and was taking on her initial load and was ready to depart when she sprung a leak, sank, and broke in two. Much difficulty was experienced in getting the same out of the way and as a last resort she was dynamited and broken into pieces for easy dragging away. This accident caused a considerable decrease in shipments of stone for a period of about one week.

The following table shows the shipments of stone from this quarry for the seasons stated, in tons:

Season of—	Rubble-stone.	Capping stone.	Total.
	<i>Tons.</i>	<i>Tons.</i>	<i>Tons.</i>
1897.....	27,501.5	883.4	27,884.9
1898.....	97,269.7	16,078.7	113,348.4
1899.....	111,557.4	42,425.1	153,982.5
1900.....	122,946	54,988.7	177,934.7
1901.....	167,795.1	77,581.7	245,326.8
1902.....	137,279.2	93,470.9	230,750.1
Total .....	664,348.9	284,878.5	949,227.4

#### SOUTH HARBOR SECTION TIMBER-CRIB CONCRETE BREAKWATER.

This breakwater, 2,739 feet long, measured along the lake face, was originally a timber-crib structure similar to the Stony Point section, with the exception that the cribs are 180 feet long instead of 60 feet. The whole timber structure was completed on October 27, 1900. This breakwater suffered great damage by storms of September 12, 1900, and November 21, 1900. In consequence of this 1,800 linear feet of superstructure was rebuilt with a concrete superstructure of the shell type, consisting of semisubmerged concrete blocks serving as a foundation for concrete walls, filled in with rubblestone and then covered over with solid concrete decks. This concrete superstructure was completed on May 18, 1902, at a cost of \$195,345.62.

At the beginning of the fiscal year, July 1, 1902, the cost of this breakwater was as follows:

Trench excavation .....	\$64,342.98
Trench filling .....	41,820.35
Rubblestone foundation .....	83,092.37
Timber-crib work .....	255,218.31
Mooring cleats, posts, and extra timber.....	2,723.62
Repair work .....	4,340.00
Concrete superstructure .....	195,345.62
Total cost, July 1, 1902 .....	646,883.25

This breakwater lying across the axis of Lake Erie is subject to tremendous sea action, especially during the prevalence of western storms

and gales, and after the damage sustained by it from the gales of the fall of 1900 it became expedient to strengthen the foundation by placing additional stone as riprap along the lake face. At the beginning of the fiscal year 1902, a considerable quantity of this stone had been deposited. At the same time the contractors were making strenuous efforts to complete the adjoining stone breakwater, using up all available stone as fast as quarried, and for that reason but little foundation and riprap stone was deposited during the months of July and August, and none in September. However, 12,579.8 tons were deposited during the months of October, November, and December, which, with the 999.3 tons placed during July and August, made 13,579.1 tons for the latter half of the season of 1902.

During the winter of 1902-03 some damage was done by storms to the concrete superstructure, the greatest damage occurring to section 39, where three of the large concrete blocks, each weighing over 19 tons, were washed out. As soon as possible after the opening of the season of 1903 this damaged work was protected by placing in front of it a large deposit of riprap stone. The whole length of the lake face is now being thoroughly riprapped, the stone being so placed as to come well above the water surface and extending with a moderate slope seaward. The amount of riprap placed during the months of April, May, and June, 1903, was 17,430.5 tons.

In addition to the stone placed under breakwater contracts, about 20,000 tons of stone excavated from the Buffalo River and Erie Basin, under city and State contracts, was allowed to be dumped, under supervision, along the lake face of this breakwater.

#### ENTRANCE CHANNEL TO BUFFALO RIVER AND CITY SHIP CANAL.

This entrance channel between the United States north and south piers was maintained by the United States up to 1872, when the city of Buffalo assumed that maintenance and continued it until 1900. The act approved June 6, 1900, making provisions for emergencies in river and harbor works provided that "the sum of \$10,000, or so much thereof as may be necessary, may be diverted from the amounts now available for maintenance of Buffalo Harbor in deepening the entrance to Buffalo Harbor and the City Ship Canal." Under this provision the entrance channel was dredged where necessary to make the channel 22 feet deep at mean lake level, July-November, 1900. The limits of the channel were defined at the inner end to be on a line across the end of the City Ship Canal from the corner of Watson elevator dock to the south line of the United States property on the south pier and across the Buffalo River from the corner of the Watson elevator dock to the west side of Evans slip. The channel was dredged to within 20 feet of the piers and beyond the end of the south pier 400 feet, making a channel 180 to 200 feet wide between the piers and 300 feet wide beyond the end of the north pier. Sand and mud to the amount of 37,135 cubic yards, scow measure, was removed; cost, \$9,999. There still remained a rock shoal on the north side of the channel just west of Evans slip to be removed.

The river and harbor act of June 13, 1902, provided for the removal of this rock shoal. The work of drilling and blasting the

rock was begun on October 22, 1902, with one steam-drill boat operating two drills, and completed on November 14, 1902. The number of holes drilled and blasted was 244, aggregating 798 linear feet. The area covered was 12,000 square feet. The excavation of the blasted rock was begun November 18 and completed December 20, 1902, 1,994 cubic yards of rock, scow measure, being removed, and a depth over the entire shoal of 22 to 24 feet being secured. The cost of this work, exclusive of superintendence, was \$4,482.33.

#### REPAIRS ON PIERS AND BREAKWATERS.

No repairs were made on the north and south piers during the fiscal year.

The walls and decks of the timber portion of the old breakwater were repaired during May, June, and July, 1902, at a total cost not exceeding \$500.

#### CARE OF PUBLIC PROPERTY.

The inspection steamer *Gen. John M. Wilson* was on duty through out the year.

#### OCCUPATION OF THE UNITED STATES NORTH PIER BY THE DELAWARE, LACKAWANNA AND WESTERN RAILROAD COMPANY.

This pier is the only one of the Government harbor works permanently occupied by corporations or private parties.

The occupancy was begun in 1878. A history of this occupancy and copies of official documents relating thereto are given in the Report of the Chief of Engineers for 1889, pages 2373-2383, and in the report for 1898, page 2775 et seq.

#### CONDITION OF THE WORKS.

At the close of the fiscal year the condition of the works was as follows:

*Entrance channel and piers.*—These works, forming the entrance to the inner harbor, which comprises Buffalo Creek and the City Ship Canal, were in fair condition.

The north pier remains in possession of the Delaware, Lackawanna and Western Railroad Company and is kept in repair by that corporation.

The south pier was rebuilt with concrete from its inner end to the Buffalo light, 1,425 feet, in 1900-1901, and placed in a permanent condition. The remainder of this pier, 350 feet long at the outer end, is a timber-crib, stone-filled pier, built over thirty years ago, and the superstructure is now so badly decayed that its entire reconstruction is urgently necessary.

The reconstruction should be in concrete to conform to the remainder of the pier and place it in a permanent condition. Such reconstruction of the superstructure is estimated to cost \$70 per linear foot,

including contingencies and engineering, or \$24,500 for the 350 linear feet.

As the old timber work is so badly decayed that the wall timbers are liable to fall out, the proposed reconstruction should not be delayed.

The entrance channel between the piers has been improved and maintained by the United States from its inner end at the junction of Buffalo Creek and the City Ship Canal to deep water in the lake since 1899, the river and harbor act of March 3, 1899, and of June 13, 1902, having made special provision for such improvement and maintenance, which is on the basis of securing 22 feet depth at mean lake level. The portion requiring dredging to maintain this depth is that lying between the piers for the width admissible, viz, 200 feet, widening to 400 feet beyond the outer end of the north pier. The channel is of the required depth throughout, but shoaling occurs frequently off the end of the south pier.

*Breakwater system and outer harbor.*—This system comprises four sections of breakwater separated by three entrance channels.

The north breakwater, 2,200 feet long, is a permanent concrete structure and is in good condition. This section was built under a special project, but is essentially a link in the breakwater system.

The old breakwater, 7,608 feet long, of which 4,894 feet is in permanent concrete form and 2,714 feet is timber cribwork, in good condition, except the older portions of the timber work, which require repairs estimated to cost \$5,000.

The south harbor breakwater is 10,000 feet long. This is a part of the breakwater extension to Stony Point and is not yet fully completed under the existing contracts for that work. The northerly 7,250 feet is of rubblestone type, a permanent form when fully completed, and at the close of the fiscal year 6,000 feet was fully completed as specified in the contract, but requires reenforcement along the inner toe with riprap stone to insure absolute stability under all conditions of storms.

Of the remaining 2,739 feet of this section of breakwater, 1,800 feet is of the timber-crib-concrete type, a permanent form when fully completed, but not yet so considered, as it requires heavy reenforcement on the lake side by riprap to form a sea slope to withstand the enormous wave force to which it is exposed, and 939 feet is of the original timber-crib type, in good condition, but also requiring similar reenforcement.

At the close of the fiscal year this portion was in good condition and the reenforcement on the lake side with heavy stone riprap had been advanced so that the entire lake front was protected by riprap up to the water line and above in places.

The Stony Point breakwater is 2,803 feet long, connecting with the snore, is of the timber-crib type, and is in good condition.

The outer harbor basin is in good condition, with a depth of water generally 20 to 28 feet deep at mean lake level outside of the harbor line.

#### PROPOSED OPERATIONS AND REMARKS.

The work now in progress on the final reenforcement of the breakwater extension to Stony Point is to be finished during the season of 1903 under the existing contract and supplemental contracts to the



extent possible with the available funds. It must be recognized that in a work of the magnitude of this extension, with new and untried features, and with the unfavorable conditions of a soft clay bottom and a tremendous wave force to contend against, exact requirements could not be accurately foretold. It is now, however, plainly apparent that the entire lake front of the timber-crib-concrete portion of the South Harbor section of the breakwater system must be provided with a sea slope laid to the lines and capped with large capping stones in all respects similar to the sea slope of the stone breakwater adjoining it. The reenforcement of the toe of the harbor wall of the stone breakwater is also now found to be important to insure the absolute stability of that structure.

This work of reenforcement should not be delayed, and a further appropriation will be required therefor and should be made as soon as practicable.

The cost of this work is estimated at \$200,000, including contingencies, and involves the placing of 150,000 tons of rubble and capping stone. The entire work should be done during the season of 1904.

The only appropriations hereafter required for Buffalo Harbor under the existing project will be for maintenance. It is difficult, and in fact impossible, to tell how much money will be required for this purpose. None of the timber-crib breakwater structure is in immediate need of having its wooden superstructure replaced with concrete, but it is always liable to injury by storms, etc., and true economy requires that repairs quickly follow injuries.

As the Government has over 4 miles of breakwater at this port, besides the entrance piers, there is evident likelihood that considerable sums may be required for their maintenance until all have been placed in a permanent stone or concrete form. The Government has assumed charge of the entrance channel to the extent of keeping it dredged out to the requisite depth for the large vessels trading here. The moving sands and currents tend to shoal this channel, which must be dredged out periodically.

Dredging will also be required in parts of the outer harbor basin as the demands of commerce increase. At the present time such dredging is needed to deepen the entrance to the canal of the Lackawanna Steel Company at Stony Point to 23 feet at mean lake level, and dredging will be required at other points along the harbor line as the commerce of the outer harbor develops.

For maintenance, funds are required for rebuilding the superstructure on 350 feet of the south pier, and also for maintaining the entrance channel and repairing structures, as noted under "Condition of works."

*Work yard and slip.*—For many years past the need of a storage ground, work yard, and slip for loading and unloading timber and other materials used in harbor construction has been apparent. The Government has no place for storage and dockage of this character and the rental of property for the purpose is not feasible or desirable in a crowded port like Buffalo.

Plans and estimates for such a work yard and slip have been made from time to time. On August 27, 1902, Maj. T. W. Symons submitted to the Chief of Engineers a report with plans and estimates for a work yard and slip on United States property at the United States

south pier, in which the matter was discussed at length and information on the subject given in detail, as follows:

(1) I have the honor to state that there is considerable floating plant belonging to the Government and which has been used in building the new breakwater and must be kept on hand in the future for maintenance, repair work, etc. There is no proper place controlled by the Government in which this plant can be kept, neither is there any well situated and improved ground belonging to the Government where repair materials can be collected, stored, and assembled.

(2) To meet these wants it is proposed to create on land now under water owned by the Government a storage and work yard and slip for the floating plant. This would be well situated just in advance of the main Buffalo light-house, on the south pier.

(3) The work to be done to make this yard and slip is to erect a pile and sheet pile retaining wall along the area inclosed and the sides of the slip and to fill in the inclosed area between the outer pier line and the slip and adjacent to the southern slip wall.

(4) The whole proposed improvement is located on land owned by the United States, deeded by the State of New York.

Additional information was submitted in a further statement by Major Symons in response to an indorsement on the original report by the Chief of Engineers, on November 19, 1902, as follows:

The Government has expended on the improvement of Buffalo Harbor about \$5,000,000, most of it for structures which are exposed fully to the fiercest storm action and require careful watching and more or less constant repairs, and it is probable that in the near future other works will be constructed in the immediate vicinity involving as much more. In all this work which has been done under the War Department there has never been any provision made for a suitable and permanent home for a Government workshop, storage yard, dock, slip, etc.

For the first part of my stay in Buffalo the Government was occupying the very unsatisfactory quarters furnished by the State of New York, apparently rent free, but in reality at a high rental, for it was afterwards decided that the property belonged to individuals and the courts adjudged that rental must be paid. Since then we have been camping out, so to speak, with materials stored here and there, in poor localities, where much of it was stolen and all too liable to destruction, and our floating plant looked after by the contractors for the breakwater.

The breakwater is about completed and the contractors will leave and some other course must be adopted, and I have outlined in the within letter the course which I believe proper to adopt. I know of no adequate and proper accommodations that can be secured by purchase or hire that would be as satisfactory in extent and location and as economical as that proposed. Harbor-front property in Buffalo is held at very high prices.

As the Government owns the land which it is proposed to improve it may be stated generally that accommodations approaching those which would be provided by the expenditure proposed would, if purchased, cost at least two or three times that amount, even if they could be found at all in this congested harbor. It does not seem to me that the amount to be provided for the purpose indicated is at all excessive, considering the magnitude of the interests involved.

Our floating plant consists of a steel survey and inspection steamer, the *Gen. John M. Wilson*, a catamaran survey scow, the *Gemini*, 120 by 30 feet, a house boat and some small boats. The work of keeping in repair the piers and over 4 miles of breakwater, and the great desirability of often doing the work in a hurry, necessitates keeping on hand a large amount of new and old materials, tools, etc., and renders it very desirable that we have a large work yard and storage yard conveniently located to the water.

I believe that for the care of existing works and the conduct of future work in this vicinity the proposed yard and slip will prove an economical investment of Government funds, such an investment as a good business man with similar problems and prospects as those before the Government would certainly make.

On assuming charge of this district in May last I was at once impressed with the lack of a proper place to store timber and stone and concrete materials needed for the maintenance of the Buffalo Breakwater and to care for the floating plant used in harbor work.

I therefore reconsidered the plans and estimates for the proposed work yard and slip and submitted a report, with estimate of cost and tracing showing the plans, on July 11, 1903, as follows:

I find it, however, desirable and advisable to substitute for the original new plans and estimates for the proposed work, which would increase the estimated cost to \$73,600 in round numbers. The accompanying tracing shows the revised plans and estimates in connection with the similar construction proposed to be done by the Light-House Department; and I would respectfully request that, in further consideration of the matter, the plan and estimate shown on the tracing herewith be adopted and the original tracing accompanying report of August 27, 1902, be canceled.

It may be stated here that the increase in the estimate is due to an increased amount of filling required to fill in the area between the two slips. In the original estimate the filling in of this area was not provided for. It is considered essential to thorough and stable construction.

\* \* \* \* \*

The proposed construction of a storage ground and slip, as outlined in the original recommendation of August 27, 1902, is based upon the fact that no adequate and proper accommodations for the storage of United States engineer materials, floating plant, etc., and a work yard now exist, nor can such accommodations be acquired anywhere in the harbor of Buffalo that would meet the required conditions as satisfactorily, advantageously, and economically as the method proposed.

To demonstrate this there is submitted herewith a tracing<sup>a</sup> showing the inner harbor at Buffalo, N. Y., which consists of three parts, viz, the Buffalo River, City Ship Canal, and Erie Basin. \* \* \* There are very few slips connecting with the water highways of the harbor, and these few slips are all adjuncts to large elevators or lumber and merchandise docks, or connecting water highways where floating plant can not be stored without prohibitory obstruction to navigation. Owing to the crowded condition of the inner harbor, and the current, and in conditions as described in Bulletin No. 13, Survey of the Northern and Northwestern Lakes, under the heading "Buffalo Harbor," no floating plant could be stored on the Buffalo Creek or Ship Canal frontage with any degree of safety. A slip connecting with these water highways would be essential.

\* \* \* All of the frontage on the three parts of the harbor is fully occupied by large commercial interests, elevator corporations, railroads, etc. The assessed valuation of this property is about \$300 per foot front.

The small "islands" marked "A" and "B" are the only unused tracts in the whole harbor, and even these could not be purchased for less than \$300 per foot front, or \$100,000 for either "island." They are in a dilapidated condition, and would need new dock fronts and reconstruction, at a cost of not less \$30,000, and even after this outlay would afford no safe storage for floating plant, owing to their exposure to the most severe current, and in present conditions, and situated as they are, would require watchmen to be constantly on guard to protect anything stored there.

It is hoped that the data given \* \* \* demonstrate with sufficient clearness the fact that there is no suitable site for the proposed storage ground and slip in the inner harbor. The knowledge of this fact and other conditions noted below led to the original recommendation to construct a storage ground and slip on United States property in the outer harbor. For many years past the care of the United States engineer property and floating plant has been costly and unsatisfactory. Up to a few years ago a dock was occupied in the Erie Basin. It soon became filled with an accumulation of timber and iron and working outfit for breakwater construction and its limited frontage was crowded with the floating plant used on harbor works. The owners of the property instituted a claim for rental amounting to some \$22,000, and the matter had to be finally settled in the United States courts. The grounds were so ill adapted to the required use and so limited to accommodate the United States property that in 1895 steps were taken to improve the conditions so far as possible. The floating plant was suffering damage at inadequate moorings, and an application for the transfer of a large part of it to the Duluth district, together with a lot of machinery, was an acceptable relief in the emergency. Other property was disposed of, and in 1896 a substantial storehouse was erected on the United States property at the United States south pier. \* \* \* Since then this locality has been occupied as a base for supplies and storage; but timber can only be stored on the extreme end of the south pier, an area 300 feet long and 24 feet wide, and then only in a limited quantity, due to liability of damage to the pier structure by overloading.

---

<sup>a</sup> Not printed.

During the past two years storage room was needed for timber, and the only available room was found at the extreme end of the Lehigh Valley basins, some 3 miles' towing from the breakwater. Then this storage room was needed by the owners, and for want of other storage room the timber had to be crowded on the south pier, and arrangements made for transferring the larger part of it to Dunkirk Harbor. The floating plant has in the meantime been stored wherever a place could be found—at the breakwater during the working season and in the Erie Canal during the winter, when it is closed to navigation. This method of storage involved considerable risk at insecure moorings, loss of property by theft, and employment of additional watchmen, besides the watchmen at the storehouse proper. The storehouse was built, as stated, on the United States property with the view of concentrating there the various facilities needed in connection with harbor improvements, after many years' experience with temporary arrangements involving many difficulties, disadvantages, and expense.

The construction of the proposed storage ground and slip is the final step needed to complete the plan, and it would be, undoubtedly, the best and cheapest solution of the problem.

It may be noted here that the construction of the storage area as proposed would in effect extend the United States south pier some 300 feet lakeward, and secure desired protection to the entrance channel against the encroachment of the bar off the end of this pier. The proposed location of the storage and work yard has a great advantage over any other possible location, from being under the constant supervision, without additional expense, of the men employed in the Light-House and Life Saving departments, and being most conveniently located for work in connection with the breakwaters and least liable to vandalism and theft.

The land to be secured by the fill within the bulkheads as proposed would be 3.38 acres. This is exclusive of the proposed roadway indicated on the plans, which roadway is not included in the plans or estimate of cost for the reason that it is proposed to construct it, at practically no cost, from time to time, from refuse stone in the south pier and in connection with proposed plans for additional storage ground and slip for the Light-House Department, indicated on the tracing herewith. The roadway would be more germane to the existing and proposed Light-House Department improvements, and its cost would be included in the estimate for that work, except on the beach east of the present Life-Saving and Light-House properties, where leveling can now be done, and where the improvement of a road simply implies dumping of refuse material from the pier.

The United States engineer storage ground would be used almost entirely for storage of materials brought to it by boats, and all transportation to it could be done by boat.

\* \* \* It is recommended that the project for the improvement of Buffalo Harbor be extended so as to provide for the proposed work yard and slip, at the estimated cost of \$73,600.

The estimate of funds required may be summed up as follows:

#### *Maintenance.*

For reenforcement of the breakwater extension to Stony Point .....	\$200, 000
Concrete superstructure on south pier .....	24, 500
Repairs of structures .....	10, 000
Dredging entrance channel .....	10, 000
Dredging outer harbor at Stony Point .....	10, 000
<b>Total .....</b>	<b>254, 500</b>

#### *Money statement.*

July 1, 1902, balance unexpended .....	\$449, 670. 29
June 30, 1903, amount expended during fiscal year .....	337, 273. 17
<b>July 1, 1903, balance unexpended .....</b>	<b>112, 397. 12</b>
<b>July 1, 1903, amount covered by uncompleted contracts .....</b>	<b>Indefinite.</b>

{ Amount that can be profitably expended in fiscal year ending June 30, 1905, for maintenance of improvement, in addition to the balance unexpended July 1, 1903. .... 254, 500. 00  
 Submitted in compliance with requirements of sundry civil act of June 4, 1897, and of section 7 of the river and harbor act of 1899.

## STATEMENT OF ALLOTMENTS AND APPROPRIATIONS.

May 28, 1826 .....	\$15,000.00	March 3, 1875 .....	\$100,000.00
May 19, 1828 .....	34,206.00	August 4, 1877 .....	85,000.00
April 23, 1830 .....	15,488.00	June 18, 1878 .....	80,000.00
March 2, 1831 .....	12,900.00	March 3, 1879 .....	100,000.00
July 3, 1832 .....	10,300.00	June 14, 1880 .....	90,000.00
March 2, 1833 .....	31,700.00	March 3, 1881 .....	90,000.00
June 28, 1834 .....	20,000.00	August 2, 1882 .....	125,000.00
July 7, 1838 .....	68,500.00	July 5, 1884 .....	100,000.00
June 11, 1844 .....	40,000.00	August 5, 1886 .....	112,500.00
August 30, 1852 .....	14,000.00	August 11, 1888 .....	225,000.00
March 3, 1853 .....	349.05	September 19, 1890 .....	300,000.00
March 2, 1855 .....	452.32	July 13, 1892 .....	300,000.00
June 28, 1864 .....	15,000.00	August 18, 1894 .....	70,000.00
July 2, 1864 .....	37,500.00	June 4, 1897 .....	481,250.00
June 23, 1866 .....	131,000.00	July 1, 1898 .....	489,746.00
March 2, 1867 .....	100,000.00	March 3, 1899 .....	485,498.00
April 10, 1869 .....	89,100.00	March 3, 1899 .....	75,000.00
July 10, 1870 .....	80,000.00	March 3, 1901 .....	400,000.00
March 3, 1871 .....	100,000.00	June 13, 1902 .....	30,000.00
June 10, 1872 .....	75,000.00	June 28, 1902 .....	200,000.00
March 3, 1873 .....	75,000.00		
February 23, 1874 .....	20,000.00	Total .....	4,999,489.37
June 23, 1874 .....	75,000.00		

## CONTRACTS IN FORCE.

*Contract for extension of breakwater and sand-catch pier at Buffalo, N. Y.*

Name of contractor: Hughes Brothers & Bangs, Syracuse, N. Y.

## Rates:

## Rubble mound—

Rubblestone .....	ton..	\$0.80
Capping stone .....	do...	1.25
Gravel .....	cubic yard..	.13

## Timber crib:

Excavation .....	do...	.18
Gravel .....	do...	.13
Foundation stone .....	ton..	.80
Timber cribs .....	linear feet..	92.37
Mooring cleats .....	each..	6.00
Mooring posts .....	do...	36.00

## Sand-catch pier:

Piles .....	do...	11.00
Waling .....	linear foot..	.25
Tie-rods, etc .....	pound..	.02½
Pile shoes .....	each..	.25
Stone filling .....	cubic yards..	1.06

Date of approval: February 19, 1897.

Date of commencement: May 19, 1897.

Date of expiration: December 31, 1902.

# 2140 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

*Supplemental contract for repairing damage to rubble-mound breakwater at Buffalo, N. Y.  
dated December 31, 1902.*

Name of contractor: Hughes Brothers & Bangs, Syracuse, N. Y.

## Rates:

Hire of derrick scows.....	per month..	\$660.00
Tugs—		
Class A .....	do.....	660.00
Class B .....	do.....	440.00
Class C .....	do.....	225.00
Deck scows .....	do.....	260.00
Dump scows .....	do.....	200.00
Yawl boats .....	do.....	26.00
Diving scow, dress and pump .....	do.....	80.00
Small scows .....	do.....	13.00
New rubblestone .....	per ton..	.80
New capping stone .....	do.....	1.25
Date of approval, January 14, 1903.		
Date of commencement, May 1, 1903.		
Date of expiration, October 1, 1903.		

## COMMERCIAL STATISTICS OF BUFFALO HARBOR, NEW YORK.

[Compiled from records furnished by collector of customs and from annual reports of the Merchants' Exchange of Buffalo, N. Y.]

### *Arrivals and departures of vessels for the year ending December 31, 1902.*

Vessels.	Arrivals from—				Departures to—			
	Home ports.		Foreign ports.		Home ports.		Foreign ports.	
	Num-ber.	Tons.	Num-ber.	Tons.	Num-ber.	Tons.	Num-ber.	Tons.
Steam.....	3,264	5,087,423	360	266,760	3,373	5,134,694	299	165,692
Sail and barges.....	282	210,069	964	304,906	327	241,933	945	294,803
Total.....	3,546	5,247,492	1,324	571,666	3,700	5,376,627	1,244	460,495

### Total arrivals and departures:

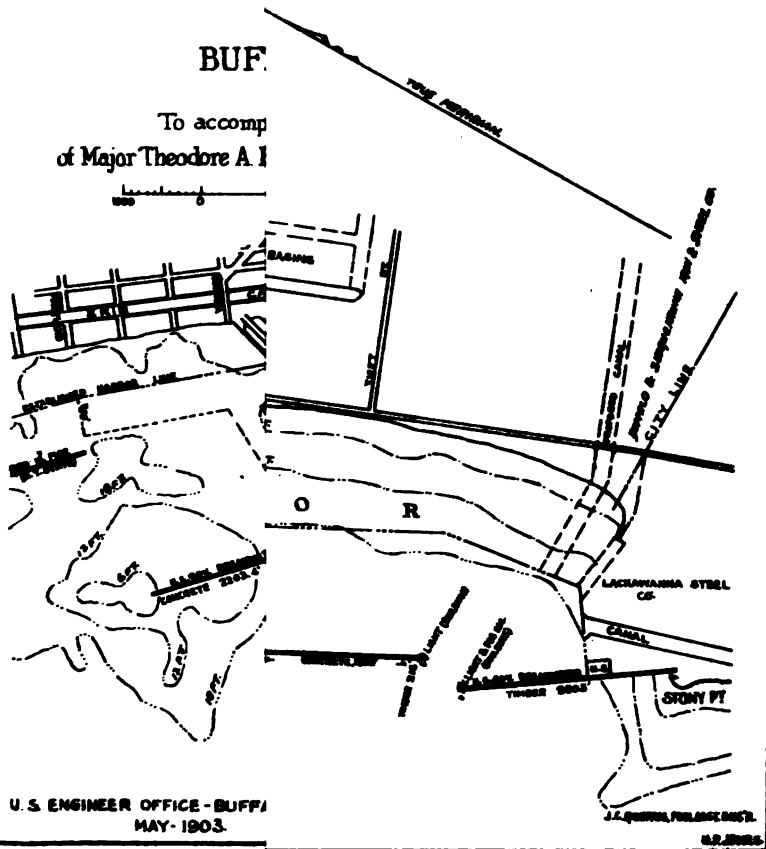
Number .....	9,814
Tonnage.....	11,656,280
Increase of tonnage, 1902 over 1901.....	1,201,600
Amount of revenue collected, year 1902:	
Lake commerce.....	\$171,092.23
Rail commerce.....	725,459.90
Total.....	896,552.13
Value of imports: <sup>a</sup>	
By lake .....	\$1,363,836.00
By rail .....	4,501,876.00
	5,865,712.00
Value of exports: <sup>a</sup>	
By lake.....	290,971.00
By rail .....	15,883,482.00
	16,174,453.00
Enrolled tonnage, port of Buffalo, 1902, 152,935 gross tons. Greatest draft of vessels, 18 feet.	

<sup>a</sup> Includes port of Tonawanda, embraced in Buffalo Creek district.

BUF.

To accomp  
of Major Theodore A. I

1000 0



ANDREW B. GRAHAM, PHOTO-LITHO, WASHINGTON D.C.

Eng 58 1





*Receipts by lake for the year 1902.*

[Tons of 2,000 pounds.]

Barley .....	215, 277	Oil cake .....	23, 376
Broom corn .....	5, 223	Papers .....	123
Canned goods .....	5, 431	Peas .....	7, 049
Corn .....	679, 149	Pork .....	202
Corn meal .....	2, 407	Rags .....	270
Copper .....	118, 543	Rubber .....	50
Flour .....	1, 128, 608	Rye .....	103, 240
Flaxseed .....	311, 035	Soap .....	3, 398
Feed .....	164, 189	Starch .....	34
Fish .....	5, 025	Seeds .....	17, 314
Glucose .....	20, 754	Spelter .....	11, 063
Iron ore .....	2, 386, 767	Staves .....	15
Iron pigs .....	25, 872	Stave bolts .....	208
Lead .....	16, 581	Shingles .....	13, 157
Lard .....	15, 720	Posts .....	648
Lumber .....	380, 426	Tallow .....	2, 972
Lath .....	15, 690	Ties .....	15, 290
Malt .....	5, 838	Timber .....	2, 841
Merchandise .....	60, 743	Wheat .....	1, 873, 581
Nails .....	1, 790	Wool .....	17, 042
Oats .....	254, 262		
Oatmeal .....	3, 082	Total .....	7, 909, 323
Oil .....	38		

*Shipments by lake for the year 1902.*

[Tons of 2,000 pounds.]

Coal .....	681, 971
Cement and plaster .....	613, 230
Salt .....	96, 418
Sugar .....	425, 460
Total .....	1, 817, 079

The following statistics of the canal commerce of Buffalo for the year 1902 are also compiled from the report of the Buffalo Merchants' Exchange:

Canal clearances .....	3, 275
Freight coming to Buffalo .....	tons.. 325, 310
Freight leaving Buffalo .....	do... 508, 309
Steamers and canal boats navigating from Buffalo on the canal (about) .....	700
Average freight rate, Buffalo to New York, for wheat per bushel .....	\$0. 038

Assuming that the number of arrivals of canal boats equaled the number of clearances, the grand total of the commerce of Buffalo carried on by lake, river, and canal for the season of 1902 is as follows:

	Arrivals and de- partures.	Receipts of freight.	Shipments of freight.
Lake and river .....	9, 814	7, 909, 323	1, 817, 079
Canal .....	6, 550	825, 810	508, 309
Total .....	16, 364	8, 234, 633	2, 325, 388

Total receipts and shipments, 10,560,021 tons.

## S S 4.

IMPROVEMENT OF LAKE ERIE ENTRANCE TO BLACK ROCK HARBOR  
AND ERIE BASIN, NEW YORK.

## REPORT OF OPERATIONS.

A contract for the entire channel and basin excavation of the project was entered into with the Buffalo Dredging Company, Buffalo, N. Y., April 29, 1903. The contractor at once began the construction of a large steel drill boat for drilling the rock to be excavated, and at the close of the fiscal year this drill boat was nearly completed.

Dredging operations to remove the sand overlying the rock above grade were begun on April 30. On May 1 the dredge in operation was withdrawn as unsuitable and operations were not resumed until June 20, 1903, when a large dredge was placed on the removal of sand from the channel portion of the work.

At the close of the fiscal year the channel had been excavated about 50 feet wide to the required depth of 23 feet at mean lake level, but not sufficient work had been done to be of material benefit.

## PROPOSED OPERATIONS AND REMARKS.

The work of channel and basin excavation will be continued under the contract. The contractor is expected to put at least two drill boats in operation early in July and to rapidly follow up the drilling and blasting of rock with rock dredging.

There will be required to be appropriated for the fiscal year ending June 30, 1905, \$200,000.

*Money statement.*

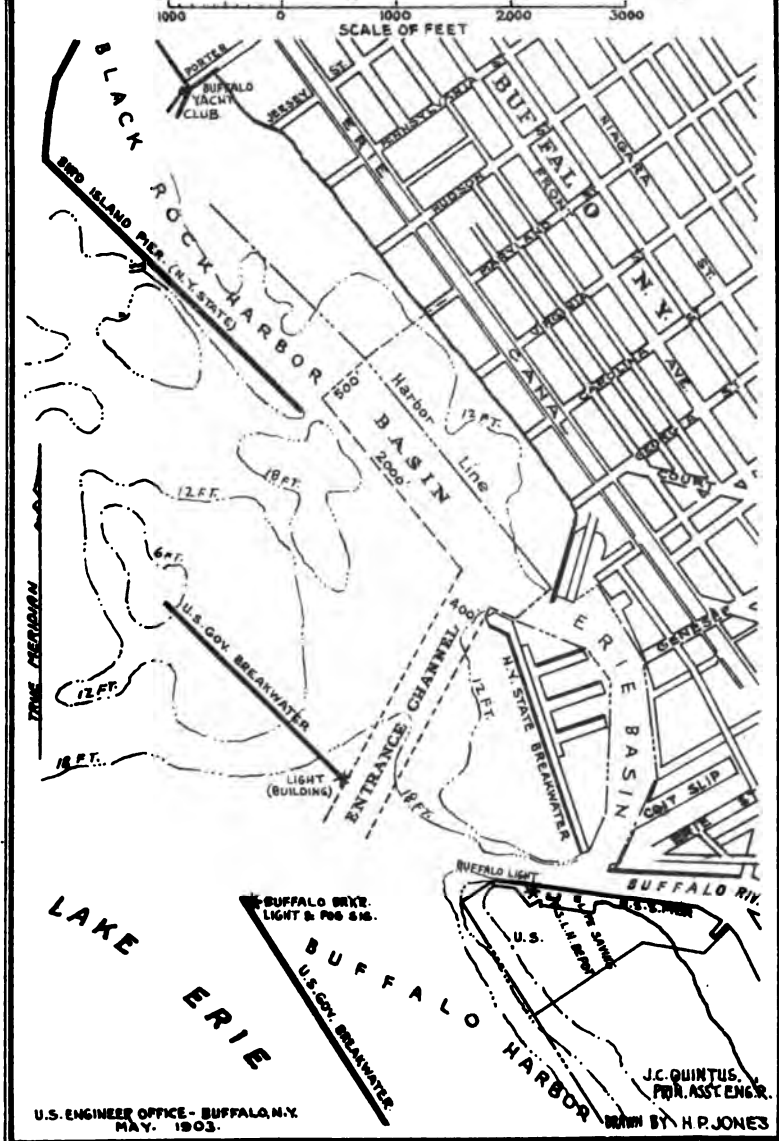
July 1, 1902, balance unexpended .....	\$200,000.00
Amount appropriated by sundry civil act approved March 3, 1903 .....	200,000.00
	<hr/>
	400,000.00
June 30, 1903, amount expended during fiscal year .....	705.50
	<hr/>
July 1, 1903, balance unexpended .....	399,294.50
	<hr/>
July 1, 1903, amount covered by uncompleted contracts .....	802,250.00
	<hr/>
{ Amount (estimated) required for completion of existing project .....	414,643.00
{ Amount that can be profitably expended in fiscal year ending June 30,	
1905, in addition to the balance unexpended July 1, 1903 .....	200,000.00
{ Submitted in compliance with requirements of sundry civil act of June	
4, 1897.	

## STATEMENT OF APPROPRIATIONS.

June 13, 1902 .....	\$200,000
March 3, 1903 .....	200,000
	<hr/>
Total .....	400,000

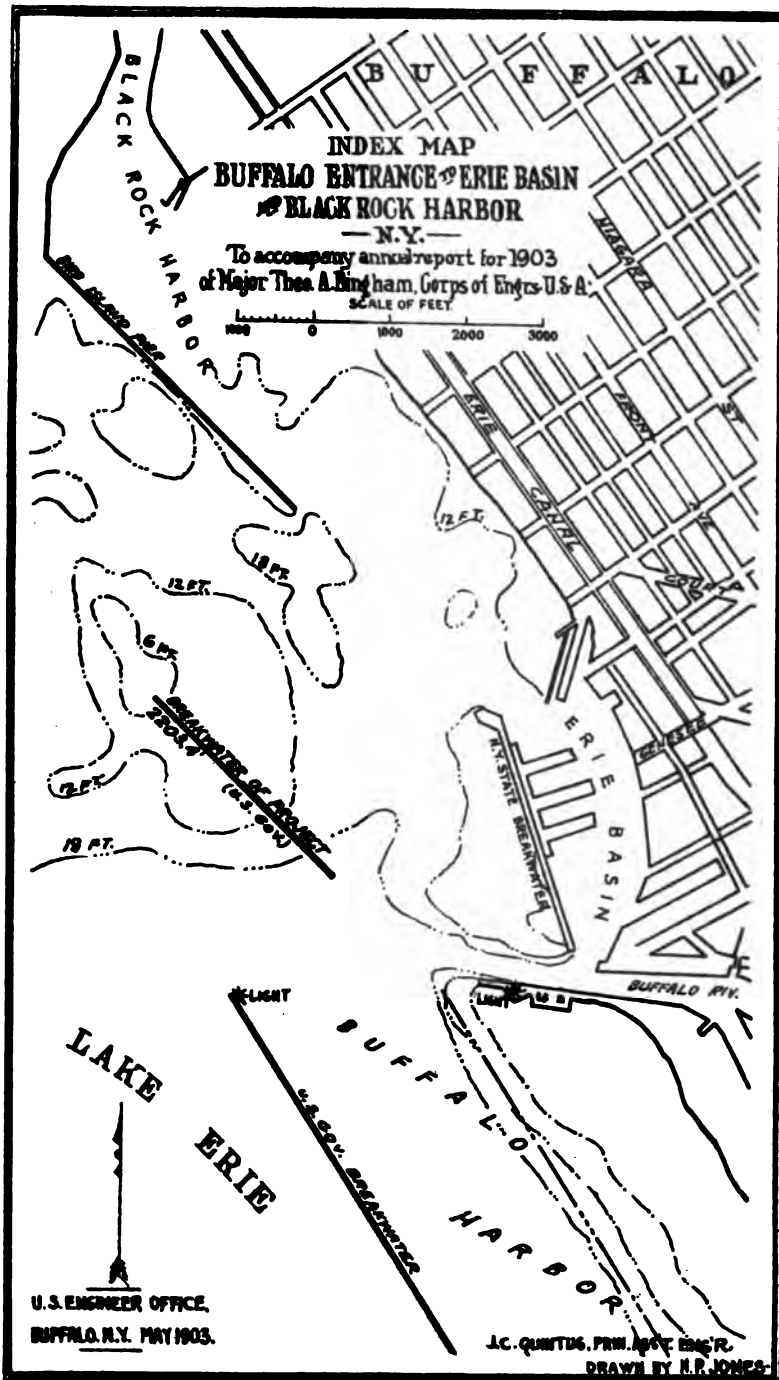
INDEX MAP  
LAKE ERIE ENTRANCE  
—TO—  
BLACK ROCK HARBOR & ERIE BASIN,  
BUFFALO, N.Y.

To accompany annual report for 1903  
of Major Theodore A. Bingham, Corps of Engineers, U.S. Army.









## CONTRACTS IN FORCE.

*Contract for excavation in Lake Erie entrance to Black Rock Harbor and Erie Basin, New York, dated February 16, 1903.*

Name of contractor: Buffalo Dredging Company.

Rates: Excavation of channel, per cubic yard, place measure, 66 cents; excavation of basin, per cubic yard, place measure, \$1.84; placing rock with derrick, per ton, \$1.25.

Date of approval: March 3, 1903.

Date of commencement: April 29, 1903.

Date of expiration: December 31, 1906.

## COMMERCIAL STATISTICS.

For the commercial statistics relating to this work, reference is made to the statistics of Buffalo Harbor. There are no means of separating the statistics relating to the portion of the harbor covered by this improvement from the general statistics of the harbor.

## S S 5.

## IMPROVEMENT OF BUFFALO ENTRANCE TO ERIE BASIN AND BLACK ROCK HARBOR, NEW YORK.

A full description of the locality and a discussion of the project for the work is printed, with map, in House Document No. 72, Fifty-fifth Congress, first session, and in Report of the Chief of Engineers for 1897, pages 3245 et seq.; and a history of the work and its completion in the Report of the Chief of Engineers for 1901, pages 3324 et seq.

## REPORT OF OPERATIONS.

There were no operations during the past fiscal year, and the entire breakwater is in good condition.

## REMARKS.

The project being completed no further estimate is made.

It is desired to keep the funds now on hand for maintenance and contingencies.

*Money statement.*

July 1, 1902, balance unexpended .....	\$3, 264. 44
July 1, 1903, balance unexpended .....	3, 264. 44

## APPROPRIATIONS.

March 3, 1899 .....	\$50, 000. 00
June 6, 1900 .....	191, 701. 25
Total .....	241, 701. 25

## COMMERCIAL STATISTICS.

For the commercial statistics relating to this work reference is made to the statistics of Buffalo Harbor. There are no means of separating the statistics relating to the portion of the harbor covered by this improvement from the general statistics of the harbor.

## S S 6.

IMPROVEMENT OF TONAWANDA HARBOR AND NIAGARA RIVER,  
NEW YORK—REPORT OF OPERATIONS.

Two hundred and fifty-seven thousand seven hundred dollars was appropriated by the river and harbor act of June 13, 1902.

Bids for the hire of dredging plant were invited July 23, 1902, and a contract was entered into with the lowest bidders, The Lake Erie Dredging Company, September 6, 1902, who commenced operations September 12, 1902, and operated four dredges on the work until work was suspended for the winter on January 12, 1903. Operations were resumed with one dredge April 15, 1903. A second dredge began work on May 11, 1903, and work was continued with these two dredges for the remainder of the fiscal year.

Dredging was confined to the shoals and channels in the vicinity of Tonawanda throughout the fiscal year, and the following work was accomplished:

The channel of Tonawanda Creek from the Niagara River to the State dam, 1,400 feet long and 160 wide, was dredged complete to the depth of 18 feet at mean river level. This work was begun in September and completed in December, 1902, as shown in the following table:

Cost of hired plant .....	\$11,882.50
Sand, clay, mud, and logs removed, scow measure .....	cubic yards.. 37,293
Cost .....	per cubic yard.. \$0.3186
Average depth of material removed .....	feet.. 1.8

The channel along the front of the village of Tonawanda, Erie County, and the channel between the Tonawanda front and Tonawanda Island, as far as the bridge, was about one-fourth completed.

This work was begun in October, 1902, and closed in January, 1903; further operations to be suspended until more urgent work is completed. The work done is shown in the following table:

Cost of hired plant .....	\$11,784
Gravel and hardpan removed, scow measure .....	cubic yards.. 24,540
Cost .....	per cubic yard.. \$0.4802
Average depth of material removed .....	feet.. 1.2

The channel across two large shoals in the main river abreast of Tonawanda Island was the most urgent work required, and this work was pushed as much as possible. Operations were begun on the upper shoal in September, 1902, and continued with two dredges until work was suspended for the winter in January, 1903.

Operations were resumed with one dredge in April, 1903, and the channel across the upper shoal, 800 feet long and 400 feet wide, and not less than 18 feet deep at mean river level, was completed May 18, 1903.

The work done on the upper shoal is shown in the following table:

Cost of hired plant .....	\$21,518
Gravel and hardpan removed, scow measure .....	cubic yards.. 62,577
Cost .....	per cubic yard.. \$0.3439
Average depth of material removed .....	feet.. 1.3

Operations were begun on the lower shoal May 18, 1903, with two dredges, and at the close of the fiscal year a channel 110 feet wide and



not less than 18 feet deep at mean river level had been completed across the shoal, which varies in length from 500 on the west side to 1,200 feet on the east side. The removal of this shoal will be both difficult and costly, owing to the hardness and extent of the hardpan met with.

#### PROPOSED OPERATIONS AND REMARKS.

The originally estimated cost of the project in 1891 was \$1,152,987.93. It may be explained that the project was extended in 1896 to the north line of the village of North Tonawanda in order to enable work to be done on the shoals at the foot of Tonawanda Island and abreast of this island and to extend the channel 400 feet wide and 18 feet deep through the shoal river along the north front of North Tonawanda.

The project was further extended in 1902 to include the dredging of the frontage on Niagara River of the village of Tonawanda, Erie County, and the dredging of Tonawanda Creek, which forms a part of Tonawanda Harbor, from Niagara River to the State dam. To allow for this work the estimate was increased \$27,000, making the revised estimate of cost \$1,199,987.93.

Taking the sum of the appropriations, \$682,700, from the revised estimate leaves \$517,287.93.

A large part of the work embraced by the original project has been done at a cost much below the original estimate. The knowledge gained in the conduct of the work indicates that this sum of \$517,287.93 will do all the remaining necessary work embraced in the original project and in the extensions of the project.

There is, however, no present demand for extending the channel 400 feet wide and 18 feet deep through the shoal river along the front of North Tonawanda from the foot of Tonawanda Island to the north line of North Tonawanda, and as the funds available will complete the necessary work above the foot of Tonawanda Island it is not deemed necessary to ask for an appropriation for the coming fiscal year.

#### *Money statement.*

July 1, 1902, balance unexpended .....	\$259, 407. 01
June 30, 1903, amount expended during fiscal year .....	49, 262. 29
July 1, 1903, balance unexpended .....	210, 144. 72
July 1, 1903, amount covered by uncompleted contracts.....	Indefinite.

#### APPROPRIATIONS.

Act of—		Act of—	
August 11, 1888 .....	\$100, 000	March 3, 1899 .....	\$75, 000
September 19, 1890 .....	75, 000	June 13, 1902 .....	257, 700
July 13, 1892 .....	75, 000		
August 18, 1894 .....	50, 000	Total .....	682, 700
June 3, 1896 .....	50, 000		

# 2146 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

## CONTRACTS IN FORCE.

*Contract for hire of dredging plant in Niagara River and Tonawanda Harbor, New York dated September 6, 1902.*

Name of contractor: The Lake Erie Dredging Company, Buffalo, N. Y.  
 Rates: Dredges, per day of eight hours, \$112; drill boats, per day of eight hours, \$112; additional tugs, per day of eight hours, \$24.  
 Date of approval: October 30, 1902.  
 Date of commencement: September 12, 1902.  
 Date of expiration: December 31, 1904.

## COMMERCIAL STATISTICS.

[Furnished by the collector of customs, Buffalo Creek and Niagara districts.]

*Arrivals and departures of vessels for the year ending December 31, 1902.*

District and vessels.	Arrivals from—				Departures to—			
	Home ports.		Foreign ports.		Home ports.		Foreign ports.	
	Num-ber.	Tons.	Num-ber.	Tons.	Num-ber.	Tons.	Num-ber.	Tons.
Buffalo Creek:								
Steam .....	70	38,006	19	4,835	78	42,442	20	253
Sail and barges .....	61	27,977	12	6,645	66	33,437	3	1,996
Niagara:								
Steam .....	280	202,845	29	8,812	283	203,223	25	9,971
Sail and barges .....	324	190,571	41	13,183	331	189,737	29	9,037
Total .....	735	459,398	101	33,475	758	468,839	77	21,256

### Total arrivals and departures:

Number .....	1,671
Tonnage .....	982,968
Decrease of tonnage, 1902 under 1901 .....	93,397
Amount of revenue collected, year 1902, Niagara district only .....	\$67,420.90
Value of imports by lake, year 1902, Niagara district only .....	\$484,011
Value of exports by lake, year 1902, Niagara district only .....	None.
Enrolled gross tonnage, Niagara district, 1902 .....	17,454
Greatest draft of vessels .....	14½ feet.

### *Receipts by lake and river for the year 1902.*

[Tons of 2,000 pounds.]

Lumber .....	717,385
Shingles .....	395
Lath .....	387
Railroad ties .....	15,825
Posts .....	2,609
Iron ore .....	238,352
Railroad iron .....	300
Total .....	975,253

Shipments by lake and river .....	None.
Shipments by Erie Canal .....	tons.. 374,023
Lumber shipments by Erie Canal .....	feet B. M.. 163,626,503

### *Number of vessels passing the International Bridge, Niagara River, 1902.*

[Furnished by R. R. McMurray, captain of the tug *International*.]

Steamers .....	6,516
Other vessels .....	1,855
Total .....	8,371
Season of navigation, April 9 to December 23, 1902 .....	days.. 258
Number of times the bridge draw was opened during season .....	3,209
Average number of times bridge draw was opened per day .....	12.43

## APPENDIX T T.

### IMPROVEMENT OF HARBORS ON LAKE ONTARIO AND OF ST. LAWRENCE RIVER AND HARBORS THEREON, NEW YORK.

*REPORT FOR THE FISCAL YEAR ENDING JUNE 30, 1903, WITH OTHER  
DOCUMENTS RELATING TO THE WORKS—OFFICERS IN CHARGE, MAJ.  
T. W. SYMONS, AND MAJ. THEO. A. BINGHAM, CORPS OF ENGINEERS.*

#### IMPROVEMENTS.

- |   |   |
|---|---|
| 1. Wilson and Oak Orchard harbors,<br>New York. | 8. Shoals in the St. Lawrence River be-<br>tween Ogdensburg, New York, and<br>the foot of Lake Ontario. |
| 2. Olcott Harbor, New York.                     | 9. Harbor at Ogdensburg, New York.  |
| 3. Harbor at Charlotte, New York.               | 10. St. Lawrence River at the head of<br>Long Sault Island, New York.                                   |
| 4. Harbor at Great Sodus Bay, New York.         | 11. Removing sunken vessels or craft ob-<br>structing or endangering navigation.                        |
| 5. Harbor at Little Sodus Bay, New York.        |   |
| 6. Harbor at Oswego, New York.                  |   |
| 7. Harbor at Cape Vincent, New York.            |   |

(For letter of transmittal see Appendix S S.)

#### T T I.

### IMPROVEMENT OF HARBORS AT WILSON AND OAK ORCHARD, NEW YORK.

#### (a) WILSON HARBOR.

#### REPORT OF OPERATIONS.

The most necessary repairs to the superstructure and decks of both piers were made in October, 1902, 12,846 feet B. M. of hemlock timber and plank being used; the cost of these repairs, for materials and labor, was \$430.57.

#### PROPOSED OPERATIONS AND REMARKS.

The commerce of Wilson Harbor by water is insignificant. It was suggested in the last annual report that, owing to the insignificance of this port and its commerce, and its proximity to the Niagara River and Olcott, it be abandoned as a port to be maintained by the United States.

The piers are in need of extensive repairs to place them in thorough condition, and the channel between the piers is not stable, filling rapidly with sand driven by storms. The channel is now, however, 9½ feet deep at mean lake level, or 7 feet deep at low water, and of a

width to admit the few vessels trading at the port—about 50 feet. A moderate amount of dredging will maintain a channel sufficient for the present needs, and the piers can also be maintained intact for a year or two longer at moderate cost.

Assuming that the harbor is to be maintained by the Government there will be required for the next fiscal year, to keep the present channel open and to keep the piers intact, but not secure against violent storms, the sum of \$3,000, in addition to the balance available. Permanently to secure the substructure of the piers by means of a low capping of concrete would require an expenditure estimated at \$29,000.

*Money statement.*

July 1, 1902, balance unexpended .....	\$2, 250. 00
July 30, 1903, amount expended during fiscal year .....	425. 39
July 1, 1903, balance unexpended .....	1, 824. 61
Amount that can be profitably expended in fiscal year ending June 30, 1905, for maintenance of improvement, in addition to the balance unexpended July 1, 1903: .....	
Submitted in compliance with requirements of sundry civil act of June 4, 1897, and of section 7 of the river and harbor act of 1899.	3, 000. 00

APPROPRIATIONS.

March 3, 1875 .....	\$10, 000. 00	June 3, 1896 .....	\$5, 000. 00
August 14, 1876 .....	10, 000. 00	May 12, 1897 .....	. 50
June 14, 1880 .....	10, 000. 00	March 3, 1899 .....	2, 500. 00
March 3, 1881 .....	10, 000. 00	June 13, 1902 .....	2, 250. 00
August 2, 1882 .....	10, 000. 00	Total .....	74, 750. 50
August 5, 1886 .....	10, 000. 00		
August 11, 1888 .....	5, 000. 00		

COMMERCIAL STATISTICS.

[Furnished by the deputy collector of customs at Wilson, N. Y.]

*Arrivals and departures of vessels for the year ending December 31, 1902.*

Vessels.	Arrivals from—				Departures to—			
	Home ports.		Foreign ports.		Home ports.		Foreign ports.	
	No.	Tons.	No.	Tons.	No.	Tons.	No.	Tons.
Steam .....	0	0	6	1, 569	0	0	6	1, 569
Sail and barges .....	0	0	2	88	0	0	2	88
Total .....			8	1, 657			8	1, 657

Total arrivals and departures (tonnage, 3,314) .....	16
Greatest draft of vessels (feet) .....	7½
Amount of revenue collected, year ending December 31, 1902 .....	\$127. 80
Value of foreign imports, year ending December 31, 1902 .....	\$788. 00
Value of foreign exports, year ending December 31, 1902 .....	None.

*Receipts by lake.*

[Net tons.]

Articles.	1898.	1899.	1900.	1901.	1902.
Lumber and logs.....	234	81	612	265	131
Fruit and merchandise.....	60				
Lath.....		12	17	39	17
Shingles.....		31	24	8	
Total.....	294	124	653	312	148

No shipments by water.

Several thousand passengers arrive and depart by water annually.

## (b) OAK ORCHARD HARBOR.

## REPORT OF OPERATIONS.

The most necessary repairs to the superstructure and decks of both piers were made in October, 1902, and 20 cords of new stone filling placed where needed in the superstructures of the piers. The cost of these repairs, for material and labor, was \$750.73, 17,680 feet B. M. of hemlock timber and plank being used.

Four cast-iron cleats for mooring were fastened on the east pier and one at the north end of west pier in place of timber heads which had rotted out.

## PROPOSED OPERATIONS AND REMARKS.

The commerce of this port is insignificant, most of the business being excursion and summer resort. The channel fills in and should be dredged annually to keep the required depth and width. The piers are decayed and need repairs.

The channel is now, however, 9½ feet deep at low water for a width of 75 feet between the piers. At the ends of the piers, where rock excavation ceased, the depth over rock is 9½ feet at low water. At the stage of water prevailing during the first half of the season of 1903, viz, mean lake level, there was an available depth of 11½ to 12 feet in the channel 75 feet wide.

This narrow channel has maintained itself to its present depth without dredging for some ten years, the last dredging having been done in 1890-1892, when the channel was reported to be 13½ feet deep at mean lake level (width not reported, but believed to have been 100 feet). A moderate amount of dredging will maintain this channel, which is sufficient for the present needs of the port, and the piers can also be maintained intact, but not secure against violent storms, for a year or two longer at a moderate cost.

It is estimated that \$3,000, in addition to the amount available, will be required for maintenance for the next fiscal year. The sum of \$35,000 would, it is estimated, permanently secure the piers by means of a low concrete capping.

# 2150 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

## Money statement.

July 1, 1902, balance unexpended .....	\$2, 250. 00
June 30, 1903, amount expended during fiscal year .....	837. 54
July 1, 1903, balance unexpended .....	1, 412. 46
[ Amount that can be profitably expended in fiscal year ending June 30, 1905, for maintenance of improvement, in addition to the balance unexpended July 1, 1903. ....	
Submitted in compliance with requirements of sundry civil act of June 4, 1897, and of section 7 of the river and harbor act of 1899. ....	
	3, 000. 00

## APPROPRIATIONS.

July 4, 1836.....	\$5, 000	August 14, 1876 .....	\$2, 000
March 3, 1837 .....	5, 000	June 18, 1878 .....	2, 000
July 7, 1838 .....	5, 000	March 3, 1879 .....	1, 000
June 11, 1844 .....	5, 000	June 14, 1880 .....	500
August 30, 1852 .....	10, 500	August 2, 1882 .....	3, 000
March 2, 1867 .....	87, 000	July 5, 1884 .....	5, 000
July 11, 1870 .....	8, 000	August 5, 1886 .....	12, 500
March 3, 1871 .....	10, 000	August 11, 1888 .....	6, 000
June 19, 1872 .....	2, 500	September 19, 1890 .....	5, 000
March 3, 1873 .....	10, 000	June 13, 1902 (allotment) .....	2, 250
June 23, 1874 .....	10, 000		
March 3, 1875 .....	10, 000	Total .....	207, 250

## COMMERCIAL STATISTICS.

### Arrivals and departures of vessels for the year ending December 31, 1902.

Vessels.	Arrivals from—				Departures to—			
	Home ports.		Foreign ports.		Home ports.		Foreign ports.	
	No.	Tons.	No.	Tons.	No.	Tons.	No.	Tons.
Steam .....	0	0	1	68	0	0	1	68
Sail and barges .....	0	0	2	189	0	0	2	189
Total .....			3	257			3	257

Total arrivals and departures (tonnage, 514) .....	6
Amount of revenue collected, year ending December 31, 1902 .....	\$245. 33
Value of imports, year ending December 31, 1902 .....	\$2, 517. 00
Greatest draft of vessels .....	feet.. 11

### Receipts by lake, 1901 and 1902.

[Net tons.]

	1901.	1902.
Posts .....	200	322
Laths .....	24	
Shingles .....	116	96
Total .....	340	418

Shipments by lake, none.

## T T 2.

## IMPROVEMENT OF OLCOTT HARBOR, NEW YORK.

## REPORT OF OPERATIONS.

No funds were available for this harbor since January, 1896, until obtained by the river and harbor act of June 13, 1902. The channel and piers had consequently greatly deteriorated. The channel had shoaled to 8 feet at low water, and dredging was urgently needed. Plans were therefore made to dredge the channel of the project, so far as funds would permit, to the depth of 13½ feet at low water (zero of Oswego gauge).

The United States dredging plant was moved from Oswego to Olcott July 21, 1902, and to August 20, when work with this plant was suspended, there had been removed from the channel between the piers 14,180 cubic yards of sand, mud, etc., at a cost of 12.7 cents per cubic yard, this price including labor, hire of tug for tender and of lake tug for towing from Oswego to Olcott and back to Great Sodus, supplies, and ordinary repairs.

The channel so far as dredged with the United States plant was parallel to the east pier and 15 feet from it, 70 feet wide and from 11 to 14 feet deep at low water. The presence of rock made it impossible to excavate with the United States plant to a uniform grade.

October 10, 1902, dredging was resumed with a powerful dredge under a written agreement with the Daly & Hannan Dredging Company. Work was carried on until December 11, when it was suspended for the season. During the progress of the work it was found that while part of the rock to be excavated by the dredge was easily and thoroughly removed, there were areas where the rock was hard and there was danger of leaving some of it above grade. It was therefore decided to employ a steam drill to loosen up the rock by blasting. A drill was furnished by the Daly & Hannan Dredging Company and the rock broken so that it could be properly removed.

Dredging was continued to May 25, 1903, and then stopped owing to exhaustion of funds.

The Daly & Hannan dredge removed 20,198 cubic yards of rock and 40,661 cubic yards of soft material, all scow measure. The total cost of this work, including the cost of drilling and blasting, was \$10,560, making the average price per yard 17.3 cents.

At the close of dredging operations a channel had been obtained 140 feet wide for the entire length between the piers and 100 feet wide for a length of 200 feet south from the inner ends of the piers, all of the required depth of 13½ feet at low water. Thence to Main Street Bridge the channel is 100 feet wide and 7 feet deep at low water. No dredging could be done lakeward from the piers owing to lack of funds. On a rock ledge 500 feet lakeward from the piers the least depth is 10 feet at low water.

Urgent repairs to the pier superstructures were made during September, 1902. Eleven thousand six hundred and forty feet B. M. of hemlock plank was used in these repairs; cost for labor and material, \$383.89.

In April, 1903, about 100 feet of the inner end of the west pier was carried away during a storm, and a breach through the sand beach between the channel and the open lake was imminent. There not being funds sufficient to rebuild the pier, the danger was guarded against by driving a line of triple sheet piling along the line of the destroyed pier 106 feet long.

The ends of the west pier and of the shore arm at right angles to this pier, which were broken away, were also repaired. The total cost of this work was \$1,084.37, labor and materials.

#### PROPOSED OPERATIONS AND REMARKS.

The commerce of Olcott is at present small, but a line of steamers from Olcott to Thousand Island points is to be established, and an electric railway line was built to Buffalo in 1900. This is a freight as well as a passenger railroad, and connects with the Erie Railroad and the New York Central and Hudson River Railroad and handles the freight cars from these roads. Summer hotels have been opened, and Olcott seems destined to become a popular summer resort, as well as a place of commercial importance.

In order to complete the channel of the project and preserve the piers, now much decayed, it is estimated that \$20,000 will be required and can be profitably expended during the next fiscal year. Of this sum \$5,000 will be needed for completing the channel of the project and for dredging where the channel fills in annually; \$5,000 will be needed to repair the most decayed parts of the two piers, and \$10,000 will be needed to rebuild the west pier for 200 feet at the inner end. The last item is important and urgent.

#### *Money statement.*

July 1, 1902, balance unexpended .....	\$15,000.00
June 30, 1903, amount expended during fiscal year .....	14,747.76
July 1, 1903, balance unexpended .....	252.24
Amount that can be profitably expended in fiscal year ending June 30, 1905, for maintenance of improvement, in addition to the balance unexpended July 1, 1903.....	
Submitted in compliance with requirements of sundry civil act of June 4, 1897, and of section 7 of the river and harbor act of 1899.	20,000.00

#### APPROPRIATIONS.

March 2, 1867 .....	\$60,000	March 3, 1881 .....	\$3,000
July 11, 1870 .....	10,000	August 5, 1886 .....	10,000
March 3, 1871 .....	5,000	August 11, 1888 .....	5,000
June 10, 1872 .....	10,000	September 19, 1890 .....	30,000
March 3, 1873 .....	10,000	June 13, 1902 .....	15,000
June 23, 1874 .....	10,000		
March 3, 1875 .....	10,000	Total .....	178,000



# APPENDIX T T—REPORT OF MAJOR BINGHAM. 2153

## COMMERCIAL STATISTICS.

*Arrivals and departures of vessels for the year ending December 31, 1902.*

Vessels.	Arrivals from—				Departures to—			
	Home ports.		Foreign ports.		Home ports.		Foreign ports.	
	No.	Tons.	No.	Tons.	No.	Tons.	No.	Tons.
Steam.....	6	203	2	108	5	166	10	4,172
Sail and barges.....			3	88			8	88
Total.....	6	203	5	196	5	166	13	4,260

Total arrivals and departures (tonnage 4,825).....	29
Amount of revenue collected year ending December 31, 1902 .....	\$11.06
Value of imports year ending December 31, 1902 .....	\$448.00
Value of exports year ending December 31, 1902 .....	None.
Greatest draft of vessels.....feet.....	7½

## *Receipts by lake, 1901 and 1902.*

[Net tons.]

	1901.	1902.
Lumber, logs, etc .....	375	477

Shipments by lake, none.  
About 10,000 passengers arrive and depart by water annually.

## T T 3.

### IMPROVEMENT OF HARBOR AT CHARLOTTE, NEW YORK.

#### REPORT OF OPERATIONS.

The dredging of the channel between the piers and lakeward therefrom was urgently needed. A written agreement was entered into with the Daly & Hannan Dredging Company, and dredging the channel between the piers and to deep water in the lake was begun August 4, 1902. The dredging was completed September 29, the amount of sand, etc., removed being 55,969 cubic yards, scow measure. The depth secured was 16½ feet at low water for a channel width of 150 feet for the entire length of the piers, and for a width of 220 feet outside the piers.

The most necessary repairs on the superstructures of both piers were made in September, 1902, 15,220 feet B. M., of white pine and 11,848 feet B. M., of hemlock timber and plank being used. The cost of this work, for labor and material, was \$940.50.

The water gauge was read three times a day throughout the year and the harbor regulations enforced.

The abandonment of the modification of project to narrow the channel to 200 feet by means of 3,600 linear feet of brush mattress and stone ballast, at an estimated cost of \$15,000, having been authorized by letter of the Chief of Engineers dated January 24, 1903, and the fund of \$15,000 turned over to maintenance, plans and preparations were made for rebuilding about 400 feet of the most decayed superstructure of the west pier with concrete. This work was authorized to be done by day labor. At the close of the fiscal year a concrete mixer was purchased and the preparatory work advanced, so that actual construction can be begun in July, 1903.

## PROPOSED OPERATIONS AND REMARKS.

Charlotte is the lake port of Rochester, and has a large commerce in coal brought by rail from Pennsylvania mines and shipped down the St. Lawrence River and to Canadian ports on Lake Ontario.

Its commerce is large and growing, and the maintenance of its harbor to the full extent of the project is advisable.

The channel maintained between the piers and to deep water in the lake is 3,800 feet long, and requires redredging annually on account of filling, caused by deposit during high water in the Genesee River of material in suspension, and also because of sand drifting into the channel from the lake.

A survey made in May, 1903, showed that the channel dredged in 1902 had deteriorated, the governing depth being now 15 feet at low water.

Portions of the superstructure of the entrance piers at Charlotte are becoming exceedingly rotten, and extensive repairs must be made or the piers will collapse. The piers are well settled down, and should when repaired receive concrete superstructure instead of being rebuilt with wood. It is estimated that at least 2,500 feet of these piers should be provided with a concrete superstructure without unnecessary delay. This will cost, it is estimated, \$35 per linear foot, or \$87,500. This concrete work would be in extension of the concrete superstructure now being built on the west pier, which is of a design suitable for not only the piers at Charlotte, but for the entrance piers at all of the harbors on Lake Ontario except Oswego.

For ordinary maintenance and dredging there will be required \$15,000, making the total amount required for the next fiscal year \$102,500.

*Money statement.*

July 1, 1902, balance unexpended .....	\$30,024.51
June 30, 1903, amount expended during fiscal year .....	8,505.67
July 1, 1903, balance unexpended .....	21,518.84

{	Amount that can be profitably expended in fiscal year ending June 30, 1905, for maintenance of improvement, in addition to the balance unexpended July 1, 1903 .....	102,500.00
	Submitted in compliance with requirements of sundry civil act of June 4, 1897, and of section 7 of the river and harbor act of 1899.	

## APPROPRIATIONS.

May 23, 1828 .....	\$300.00	March 3, 1871 .....	\$10,000.00
March 2, 1829 .....	10,000.00	March 3, 1875 .....	5,000.00
March 3, 1829 .....	13,335.00	June 18, 1878 .....	1,000.00
March 2, 1831 .....	16,670.00	March 3, 1879 .....	1,000.00
February 24, 1832 .....	16,000.00	June 14, 1880 .....	5,000.00
March 2, 1833 .....	15,000.00	March 3, 1881 .....	2,500.00
June 28, 1834 .....	20,000.00	August 2, 1882 .....	35,000.00
March 3, 1835 .....	2,390.00	July 5, 1884 .....	20,000.00
July 2, 1836 .....	20,000.00	August 5, 1886 .....	26,250.00
March 3, 1837 .....	10,000.00	August 10, 1888 .....	45,000.00
July 7, 1838 .....	25,000.00	September 19, 1890 .....	25,000.00
June 11, 1844 .....	10,000.00	July 13, 1892 .....	25,000.00
August 20, 1852 .....	20,000.00	August 18, 1894 .....	15,000.00
March 3, 1853 .....	176.10	June 3, 1896 .....	12,000.00
June 28, 1864 .....	25,000.00	March 3, 1899 .....	7,000.00
June 23, 1866 .....	75,607.30	June 6, 1900 .....	3,500.00
July 25, 1868 .....	1,100.00	June 13, 1902 .....	30,000.00
April 10, 1869 (allotment) ...	1,000.00		
July 11, 1870 .....	12,000.00	Total .....	561,828.40

<sup>a</sup> Unexpended balance of \$41.24 returned into Treasury.

## COMMERCIAL STATISTICS.

*Arrivals and departures of vessels for the year ending December 31, 1902.*

Vessels.	Arrivals from—				Departures to—			
	Home ports.		Foreign ports.		Home ports.		Foreign ports.	
	No.	Tons.	No.	Tons.	No.	Tons.	No.	Tons.
Steam.....	226	145,653	539	467,672	215	135,632	550	474,608
Sail and barges.....	92	25,925	388	125,474	27	6,986	453	144,413
Total.....	318	168,488	927	593,146	242	142,618	1,003	619,016

Total arrivals and departures; tonnage, 1,523,268.....	2,490
Increase of tonnage, 1902 over 1901.....	30,796
Amount of revenue collected, year ending December 31, 1902.....	\$5,323.79
Value of imports, year ending December 31, 1902.....	\$42,372.00
Value of exports, year ending December 31, 1902.....	\$1,720,769.78
Greatest draft of vessels.....	15 feet.
Enrolled tonnage, port of Charlotte.....	1,446 gross tons.

*Receipts by lake.*

[Net tons.]

	1899.	1900.	1901.	1902.
Poles and railroad ties.....	6,805	1,115	6,852	3,451
Lumber.....	245	586	61	546
Posts, logs, and pulp wood.....	2,401	513	2,974	4,868
Lath.....	319	.....	255	209
Shingles.....	18	14	99	238
Merchandise.....	140	250	483	27
Total.....	9,928	2,477	10,224	9,339

*Shipments by lake.*

[Net tons.]

	1899.	1900.	1901.	1902.
Coal.....	437,246	397,032	538,843	547,850
Oils and merchandise.....	231	96	140	501
Total.....	437,477	397,128	538,983	548,351

About 50,000 passengers arrive and depart by water annually.

## T T 4.

## IMPROVEMENT OF HARBOR AT GREAT SODUS BAY, NEW YORK.

## REPORT OF OPERATIONS.

The United States dredging plant was removed from Olcott to Great Sodus August 21, 1902, and to September 20, when the work was closed, had excavated 6,060 cubic yards from a bar which had formed in the channel outside the piers and from shoal spots in the channel between the piers. The depths made were 15 feet at extreme low water outside the piers and 14 feet below the same datum between the piers, the width of the channel being 150 feet. The cost per cubic yard was 15.1 cents, including labor, hire of tug, supplies, and ordinary repairs.

Eight thousand five hundred and ninety feet B. M. of hemlock plank and timber were used in repairing the decking of the piers. The total cost of the work was \$328.67, including labor and material. A survey of the channel from Great Sodus Bay to the lake was made May 20 and 21, 1903. This showed that the channel had deteriorated, so that it is now available for vessels drawing 12½ feet at extreme low water or 13 feet at low water.

#### PROPOSED OPERATIONS AND REMARKS.

The channel between the piers is 1,800 feet long and 150 feet wide from the bay to the 15-foot curve in Lake Ontario, and requires more or less dredging annually on account of shoaling, chiefly caused by the drifting in of sand from the lake. Besides the maintenance of the channel, there are 2,150 feet of breakwater and 2,874 feet of piers to be maintained.

It is estimated there will be required to June 30, 1905, for maintenance of channel and repairs to piers, \$5,000.

The commerce of this port is not large, consisting chiefly of the shipment of coal brought from Pennsylvania mines by rail.

#### Money statement.

July 1, 1902, balance unexpended .....	\$5,060.20
June 30, 1903, amount expended during fiscal year .....	2,218.78
July 1, 1903, balance unexpended .....	2,841.42
<hr/>	
{ Amount that can be profitably expended in fiscal year ending June 30, 1905, for maintenance of improvement, in addition to the balance unexpended July 1, 1903 .....	5,000.00
{ Submitted in compliance with requirements of sundry civil act of June 4, 1897, and of section 7 of the river and harbor act of 1899.	

#### APPROPRIATIONS.

March 2, 1829 .....	\$12,500.00	August 14, 1876 .....	\$5,000.00
March 3, 1829 .....	15,280.00	June 18, 1878 .....	5,000.00
March 2, 1831 .....	17,450.00	March 3, 1879 .....	2,000.00
February 24, 1832 .....	17,000.00	June 14, 1880 .....	3,000.00
March 2, 1833 .....	15,000.00	March 3, 1881 .....	5,000.00
June 28, 1834 .....	15,000.00	August 2, 1882 .....	25,000.00
March 3, 1835 .....	11,790.00	July 5, 1884 .....	10,000.00
July 2, 1836 .....	12,600.00	August 5, 1886 .....	16,875.00
March 3, 1837 .....	12,000.00	August 10, 1888 .....	24,000.00
July 7, 1838 .....	10,000.00	September 19, 1890 .....	10,000.00
June 11, 1844 .....	5,000.00	July 13, 1892 .....	15,000.00
August 20, 1852 .....	10,000.00	August 18, 1894 .....	15,000.00
June 23, 1866 .....	53,151.80	June 3, 1896 .....	8,000.00
March 2, 1867 .....	80,000.00	March 3, 1899 .....	14,000.00
July 11, 1870 .....	5,000.00	July, 1899 (repayment) ....	1.00
June 10, 1872 .....	15,000.00	June 13, 1902 .....	5,000.00
June 23, 1875 .....	15,000.00		
March 3, 1875 .....	10,000.00	Total .....	494,647.80

## COMMERCIAL STATISTICS.

*Arrivals and departures of vessels for the year ending December 31, 1902.*

Vessels.	Arrivals from—				Departures to—			
	Home ports.		Foreign ports.		Home ports.		Foreign ports.	
	No.	Tons.	No.	Tons.	No.	Tons.	No.	Tons.
Steam .....	14	1,355	25	3,452	7	1,534	24	3,477
Sail and barges .....	11	2,896	41	8,672	18	3,645	38	8,604
Total .....	25	4,251	66	12,124	25	5,179	62	12,081

Total arrivals and departures (tonnage 33,635) ..... 178  
 Decrease of tonnage, 1902 under 1901 ..... tons.. 26,028  
 Amount of revenue collected, year ending December 31, 1902 ..... \$163.92  
 Value of imports, year ending December 31, 1902 ..... \$11,778.00  
 Value of exports, year ending December 31, 1902 ..... \$59,827.00  
 Greatest draft of vessels ..... feet.. 12  
 Enrolled tonnage ..... No record.

*Receipts and shipments by lake.*

[Net tons.]

	Receipts.			Shipments.		
	1900.	1901.	1902.	1900.	1901.	1902.
Coal .....				82,260	54,598	21,251
Poles and railroad ties .....	1,462	100	375			
Posts, lumber, etc .....	508					
Merchandise .....	149		8			
Feldspar .....		3,037	5,097			
Total .....	2,119	3,137	5,475	82,260	54,598	21,251

Several thousand passengers arrive and depart by water annually.

## T T 5.

## IMPROVEMENT OF HARBOR AT LITTLE SODUS BAY, NEW YORK.

## REPORT OF OPERATIONS.

Dredging of the channel from deep water in Little Sodus Bay to deep water in Lake Ontario was begun by the United States dredging plant September 21, 1902, and up to December 4, when work was suspended, 19,345 cubic yards of sand and other soft material had been removed, at a cost of 14 cents per cubic yard. This cost included the hire of tugs, labor, fuel, repairs while working, and the laying up of the dredging plant for the winter, also the repairs to dredge machinery while laying up. The channel was made 100 feet wide and 15 feet deep at extreme low water from the bay to the lake. Eight thousand six hundred and sixty-eight feet B. M. hemlock plank and timber were used in repairing both piers, at a cost, including labor and materials, of \$226.24.

The river and harbor act of June 13, 1902, provided for the extension of the east pier 300 feet eastward. On June 2, the contractors for the extension of the east pier began the preparation of foundations, and at the close of the fiscal year were about ready to begin the construction of the timber cribs.

Substructure for the timber crib concrete pier to be built under the contract in force.

## PROPOSED OPERATIONS AND REMARKS.

A survey made in June, 1903, showed that there was a channel from the bay to the lake with a least width of 100 feet and a least depth of 13½ feet at low water.

The entrance channel is 2,300 feet in length from the bay to the 15-foot curve in the lake. It requires more or less dredging annually on account of shoaling, caused chiefly by the drifting of sand from the west.

Besides the maintenance of this channel, there are 4,937 feet of piers and breakwaters to be maintained, viz: The west pier, 1,747 feet; the east pier, 1,510 feet; and the east breakwater, 1,680 feet. The west breakwater is entirely covered by accretions of sand. The piers are much in need of repairs, portions of them being very rotten. These portions must soon be thoroughly repaired or they will collapse and be carried away by the seas. When these repairs are made it will be advisable to use concrete in place of wood for the superstructures. It is estimated that 2,000 feet of the piers should have their superstructures renewed with concrete in the near future. This will cost \$35 per foot or \$70,000.

It is estimated that there will be required to June 30, 1905:

For ordinary repairs, dredging, etc .....	\$8,500
For replacing 2,000 feet of wooden superstructure with concrete .....	70,000
Total.....	78,500

The commerce of this port consists chiefly of shipments of coal brought by rail from Pennsylvania mines and destined to Canadian ports on Lake Ontario and the St. Lawrence River.

*Money statement.*

July 1, 1902, balance unexpended .....	\$25,173.20
June 30, 1903, amount expended during fiscal year .....	3,395.10
July 1, 1903, balance unexpended .....	21,778.10
July 1, 1903, amount covered by uncompleted contracts.....	21,016.00
Amount that can be profitably expended in fiscal year ending June 30, 1905, for maintenance of improvement, in addition to the balance unexpended July 1, 1903. ....	
Submitted in compliance with requirements of sundry civil act of June 4, 1897, and of section 7 of the river and harbor act of 1899.	
	78,500.00

## APPROPRIATIONS.

August 30, 1852.....	\$10,000.00	June 14, 1880.....	\$20,000.00
April 9, 1864.....	1,778.36	March 3, 1881.....	20,000.00
April 9, 1864.....	2,224.00	August 2, 1882.....	25,000.00
April 9, 1864.....	99.00	July 5, 1884.....	10,000.00
June 23, 1866.....	33,840.41	August 5, 1886.....	12,500.00
March 2, 1867.....	50,000.00	August 10, 1888.....	16,000.00
April 10, 1869.....	1,500.00	September 19, 1890.....	13,000.00
July 11, 1870.....	5,000.00	July 13, 1892.....	6,000.00
March 3, 1871.....	15,000.00	August 18, 1894.....	8,000.00
June 10, 1872.....	15,000.00	June 3, 1896.....	8,000.00
March 3, 1873.....	15,000.00	March 3, 1899.....	5,500.00
June 23, 1874.....	15,000.00	July, 1899 (repayment) .....	1.00
March 3, 1875.....	10,000.00	June 13, 1902.....	25,000.00
August 14, 1876.....	5,000.00		
June 18, 1878.....	10,000.00	Total .....	363,442.77
March 3, 1879.....	5,000.00		

## CONTRACTS IN FORCE.

*Contract for extending the east pier at Little Sodus Bay, New York, dated March 23, 1903.*

Name of contractor: Buffalo Dredging Company.

## Rates:

Excavation for foundation, for all.....	\$1,000.00
Foundation stone, per cubic yard.....	1.60
Timber cribs, per linear foot.....	38.00
Stone in superstructure, per cubic yard.....	1.50
Hemlock timber, per M feet B. M.....	30.00
Concrete blocks, per cubic yard.....	11.50
Concrete in place, per cubic yard.....	9.00
Manhole covers, each.....	5.00
Corner posts for two.....	80.00
Mooring posts, each.....	10.00
White-oak fender, per linear foot.....	.70

Date of approval: April 7, 1903.

Date of commencement: May 10, 1903.

Date of completion: December 1, 1903.

## COMMERCIAL STATISTICS.

*Arrivals and departures of vessels for the year ending December 31, 1902.*

Vessels.	Arrivals from—				Departures to—			
	Home ports.		Foreign ports.		Home ports.		Foreign ports.	
	No.	Tons.	No.	Tons.	No.	Tons.	No.	Tons.
Steam.....	14	1,481	39	7,334	18	1,498	34	7,058
Sail and barges.....	11	2,638	61	19,190	7	2,253	64	20,068
Total.....	25	4,069	100	26,524	25	3,751	98	27,111

Total arrivals and departures (tonnage, 61,456) .....	248
Decrease of tonnage, 1902, under 1901 .....	85,433 tons..
Amount of revenue collected, year ending December 31, 1902 .....	\$1,252.66
Value of imports, year ending December 31, 1902 .....	\$7,461.00
Value of exports, year ending December 31, 1902 .....	\$184,388.00
Greatest draft of vessels .....	18 feet..
Enrolled tonnage.....	No record.

## Receipts and shipments by lake.

[Net tons.]

	Receipts.			Shipments.		
	1900.	1901.	1902.	1900.	1901.	1902.
Coal.....				52,200	133,594	48,897
Poles and railroad ties.....	6,494	517	3,584		12	
Posts and wood.....	812	995	62			
Fish.....	5	.6				
Total.....	7,311	1,512.6	3,646	52,200	133,606	48,897

Several thousand passengers arrive and depart by water annually.

## T T 6.

## IMPROVEMENT OF HARBOR AT OSWEGO, NEW YORK.

## REPORT OF OPERATIONS.

*Repairs to the substructure of outer breakwater.*—This work consisted in repairing incipient breaches in the lake walls of cribs, and was carried on by submarine divers. July to December, 1902, eleven crib pockets were emptied of stone to depths of from 9 to 18 feet below zero of Oswego gauge and corner posts were bolted to the crib walls in each of the eleven pockets, the walls drawn back to place and the stone filling and decks replaced. The cost of making these repairs, including fuel, supplies, labor, and hire of tug for towing plant was \$4,281.40, an average cost per pocket of \$389.22.

An examination of the cribs was made by divers in May, 1903, and six cribs were found where lake-face walls were pulled out from 6 to 10 inches. The repair of these cribs was fairly begun at the close of the fiscal year.

*General repairs to outer and inner breakwater.*—Five braces were placed on the banquette deck against the south parapet wall near the west end of the lake arm, outer breakwater, to support the parapet, which has become rotten and broken.

Repairs were made to the parapet and banquette decks of the outer breakwater, being chiefly the replacing of rotten and broken plank; 19.5 cords of stone were placed in the parapet near the northwest corner to replace stone lost from one of the breached cribs.

The cost of general repairs to the outer breakwater was \$1,901.36 for labor, supplies, and material.

Repairs were made to the deck of the inner breakwater at a cost of \$92.14 for labor and material.

*Dredging.*—In May, 1903, United States dredging plant removed the bar which had formed to the east of the easterly return of the outer breakwater to the depth of 18 feet at extreme low water, and in June began deepening the channel between the east and west ends of the outer harbor to 15 feet at extreme low water. Twenty-one thousand four hundred and forty-five cubic yards have been removed from the bar and channel at a cost of 14.1 cents per yard, the cost including fitting out, labor, supplies, towing, fuel, and ordinary repairs.

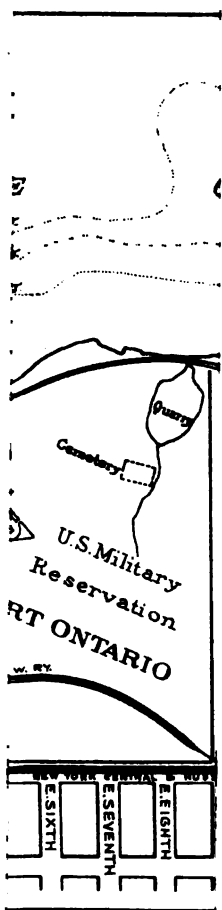
At the close of the fiscal year this channel was two-thirds completed. When finished it will be 100 feet wide and 15 feet deep at extreme low water.

During September and October, 1902, 87 cubic yards of bowlders and loose stone were taken from the channel of Oswego River near the head of the upper island. This work was done by submarine divers and the United States derrick scow. The cost was \$1,422.15, including labor, towing, etc.

In June, 1903, sheet piles were driven along the face of the undermined crib of the light-house extension pier to protect it from further damage. The piles were of oak, 30 feet long. The cost was \$709.93 for labor, material, and hire of hoisting engine.

The floating plant has been repaired and cared for, and the water gauge read tridaily during the fiscal year.







## PROPOSED OPERATIONS AND REMARKS.

It is estimated that there will be required to June 30, 1905—

For continuing rock excavation in river.....	\$25,000
For ordinary maintenance and contingencies, office expenses, superintendence, etc.....	25,000
Total.....	50,000

No estimate is made for repairs to outer breakwater, as further work on this structure and the cost thereof is understood to rest upon the recommendations of the Board of Engineers for Rivers and Harbors, to whom the report on a preliminary examination, made in accordance with the provisions of the river and harbor act of June 13, 1902, and submitted February 3, 1903, was referred.

*Money statement.*

July 1, 1902, balance unexpended .....	\$52,105.90
June 30, 1903, amount expended during fiscal year .....	11,974.78
July 1, 1903, balance unexpended .....	40,131.12
Amount that can be profitably expended in fiscal year ending June 30, 1905, in addition to the balance unexpended July 1, 1903:	
For works of improvement .....	\$25,000.00
For maintenance of improvement .....	25,000.00
	50,000.00
Submitted in compliance with requirements of sundry civil act of June 4, 1897, and of section 7 of the river and harbor act of 1899.	

## APPROPRIATIONS.

March 20, 1826.....	\$200.00	July 11, 1870.....	\$50,000.00
March 2, 1827.....	33,348.64	March 3, 1871.....	100,000.00
May 19, 1828.....	9,583.39	June 10, 1872.....	100,000.00
March 3, 1829.....	7,472.00	March 3, 1873.....	100,000.00
March 2, 1831.....	2,812.92	June 23, 1874.....	75,000.00
March 2, 1831.....	18,600.00	March 3, 1875.....	90,000.00
March 2, 1831.....	519.00	August 14, 1876.....	90,000.00
March 2, 1831.....	84.92	June 18, 1878.....	90,000.00
February 24, 1832.....	19,000.00	March 3, 1879.....	90,000.00
March 2, 1833.....	8,400.00	June 14, 1880.....	90,000.00
June 28, 1834.....	30,000.00	March 3, 1881.....	50,000.00
July 2, 1836.....	20,000.00	August 2, 1882.....	80,000.00
March 3, 1837.....	15,000.00	July 5, 1884.....	80,000.00
July 7, 1838.....	46,067.00	August 6, 1886.....	71,250.00
June 11, 1844.....	20,000.00	August 10, 1888.....	100,000.00
August 20, 1852.....	40,000.00	September 19, 1890.....	30,000.00
August, 1860 (allotment transferred from light-house).....	30,000.00	July 13, 1892.....	40,000.00
June 28, 1864 (allotment) ..	25,000.00	June 3, 1896.....	60,000.00
June 23, 1866.....	45,000.00	August 18, 1894.....	37,000.00
March 2, 1867.....	60,000.00	March 3, 1899.....	60,000.00
July 25, 1868 (allotment) ..	20,000.00	June 6, 1900 (allotment) ..	10,000.00
April 10, 1869.....	22,275.00	June 13, 1902.....	51,000.00
April 10, 1869.....	6,000.00	Total .....	2,023,612.87

# 2162 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

## COMMERCIAL STATISTICS.

### Arrivals and departures of vessels for the year ending December 31, 1902.

Vessels.	Arrivals from—				Departures to—			
	Home ports.		Foreign ports.		Home ports.		Foreign ports.	
	No.	Tons.	No.	Tons.	No.	Tons.	No.	Tons.
Steam.....	110	29,586	268	54,987	110	27,379	267	54,444
Sail and barges.....	105	21,970	217	45,176	81	14,120	225	52,640
Total.....	215	51,556	485	100,063	191	41,499	492	107,084

Total arrivals and departures (tonnage, 300,302) .....	1,383
Decrease of tonnage, 1902 under 1901.....	tons. 214,063
Amount of revenue collected, year ending December 31, 1902.....	\$90,765.52
Value of imports, year ending December 31, 1902.....	\$539,370.00
Value of exports, year ending December 31, 1902.....	\$877,621.00
Greatest draft of vessels.....	feet. 14
Enrolled tonnage, port of Oswego.....	gross tons. 29,562

### Receipts by lake.

[Net tons.]

Articles.	1899.	1900.	1901.	1902.
Lumber.....	66,954	69,216	72,744	60,790
Poles and railroad ties.....	19,534	3,667	563	6,861
Posts, pulp wood, etc.....	8,638	919	2,328	26,639
Shingles.....	5,156	3,361	2,826	8,766
Laths.....	1,781	917	2,006	4,287
Grain.....	16,215	11,231	10,690	9,832
Clay and sand.....	1,501	797	.....	.....
Miscellaneous.....	7,076	3,524	107	897
Total.....	126,864	93,632	91,264	118,022

### Shipments by lake.

[Net tons.]

Articles.	1899.	1900.	1901.	1902.
Coal.....	477,120	425,641	473,713	218,306
Merchandise.....	.....	.....	76	2,681
Total.....	477,120	425,641	473,788	215,987

About 10,000 passengers arrive and depart by water annually.

## T T 7.

### IMPROVEMENT OF HARBOR AT CAPE VINCENT, NEW YORK.

#### REPORT OF OPERATIONS.

Under the contract in force the Buffalo Dredging Company, on June 9, 1903, began excavating the trench for the foundation of the breakwater extension 300 feet long and completed it June 11, 1903.

The placing of foundation stone in the trench began June 15, and was in progress at the close of the fiscal year. No other work had been done.

## PROPOSED OPERATIONS AND REMARKS.

This breakwater is designed not to protect an anchorage, but for vessels to moor to and to protect vessels moored at the wharves at Cape Vincent, and letters from masters of vessels plying between Lake Ontario and the St. Lawrence River, and from vessel owners, testify to the value of that part of the breakwater now completed. From these letters, printed on page 3371 of report for 1901, and from observation, it would seem that the value of this breakwater to the shipping plying between Lake Ontario and the St. Lawrence River is established. The 410 feet built in 1900, while of much usefulness, is inadequate, and the speedy appropriation of funds to complete the construction of the breakwater to the full length authorized by the project is much to be desired.

The estimate for building this breakwater is \$200,000. Of this amount \$98,000 has been appropriated. It is recommended that the balance, \$102,000, be appropriated in the next river and harbor bill, so that the entire breakwater and the project may be completed.

Experience with the breakwater rendered advisable certain modifications of the structure. It is found that vessels moor to both sides of it, the preferred side depending upon the direction of the wind. This indicated the desirability of a symmetrical structure adapted to mooring on both sides, and such a structure was designed, and 300 feet of extension is now being constructed in a permanent concrete form under the contract in force, to be completed December 1, 1903.

It is believed that no further extension of the shore return is needed.

*Money statement.*

July 1, 1902, balance unexpended .....	\$49,036.01
June 30, 1903, amount expended during fiscal year .....	658.16
July 1, 1903, balance unexpended .....	48,377.85
July 1, 1903, amount covered by uncompleted contracts .....	43,065.40
<hr/>	
{ Amount (estimated) required for completion of existing project .....	102,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1905, in addition to the balance unexpended July 1, 1903 .....	102,000.00
{ Submitted in compliance with requirements of sundry civil act of June 4, 1897.	

## APPROPRIATIONS.

June 3, 1896 .....	\$25,000
March 3, 1899 .....	25,000
June 13, 1902 .....	48,000
<hr/>	
Total .....	98,000

## 2164 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

## CONTRACTS IN FORCE.

*Contract for extending breakwater at Cape Vincent, N. Y., dated March 28, 1903.*

Name of contractor: Buffalo Dredging Company.

## Rates:

Excavation for foundation, per cubic yard .....	\$0. 75
Foundation stone, per cubic yard.....	1. 60
Timber cribs, per linear foot .....	70. 60
Stone in superstructure, per cubic yard .....	1. 40
Concrete blocks, per cubic yard .....	11. 50
Concrete in place, per cubic yard.....	9. 00
Manhole covers, each.....	5. 00
Mooring posts, each .....	10. 00
White oak fender, per linear foot.....	1. 00

Date of approval: April 7, 1903.

Date of commencement: May 10, 1903.

Date of completion: December 1, 1903.

## COMMERCIAL STATISTICS.

*Arrivals and departures of vessels for the year ending December 31, 1902.*

Vessels.	Arrivals from—				Departures to—			
	Home ports.		Foreign ports.		Home ports.		Foreign ports.	
	No.	Tons.	No.	Tons.	No.	Tons.	No.	Tons.
Steam .....	4	496	806	18,787	4	496	308	18,592
Sail and barges .....	27	1,080	62	2,476	26	1,039	62	2,476
Total .....	31	1,576	368	21,263	30	1,535	365	21,428

Total arrivals and departures (tonnage, 45,802) .....	794
Decrease of tonnage 1902 under 1901.....	30,821
Amount of revenue collected year ending December 31, 1902 .....	\$41,757.11
Value of imports year ending December 31, 1902 .....	\$185,614.00
Value of exports year ending December 31, 1902 .....	\$133,886.00
Greatest draft of vessels .....	14 feet.
Enrolled tonnage, port of Cape Vincent.....	4,877 gross tons..

*Receipts by lake and river.*

[Net tons.]

Articles.	1899.	1900.	1901.	1902.
Lumber.....	1,109	2,649	2,398	716
Poles and railroad ties.....	391	2,665	.....	196
Shingles .....	218	527	739	948
Lath .....	.....	.....	50	155
Fish .....	206	382	438	580
Stone .....	.....	8,463	.....	.....
Coal .....	482	.....	350	.....
Miscellaneous .....	528	1,065	224	1,581
Total.....	2,933	10,721	4,209	4,175

Shipments by lake are: Jewelry, hardware, furs, chemicals, and other high grade manufactured articles, to the value of about \$125,000. No record of weight.  
About 18,000 passengers arrive and depart by water annually.







## T T 8.

IMPROVEMENT OF SHOALS IN THE ST. LAWRENCE RIVER BETWEEN  
OGDENSBURG, NEW YORK, AND THE FOOT OF LAKE ONTARIO.

## REPORT OF OPERATIONS.

No operations were carried on during the past fiscal year owing to lack of funds.

## PROPOSED OPERATIONS AND REMARKS.

All the shoals in American waters embraced in the project have been removed to the prescribed depth of 18 feet below the zero of the Oswego gauge (low water).

Shoals A, B, and C, also embraced in the project, are in Canadian waters. Application for permission to remove these shoals was made through the Department of State to the Canadian government, and on December 22, 1899, the necessary permission was granted.

No appropriation was made in the last river and harbor act for this work. If this project is to be completed there will be required \$40,000, and I recommend that this amount be appropriated by the next river and harbor bill.

*Money statement.*

July 1, 1902, balance unexpended.....	\$418. 06
June 30, 1903, amount expended during fiscal year.....	275. 51
July 1, 1903, balance unexpended.....	142. 55

## APPROPRIATIONS.

September 19, 1890.....	\$5, 000
July 13, 1892.....	10, 000
August 18, 1894.....	8, 000
June 3, 1896.....	25, 000
March 3, 1899.....	20, 000
Total.....	68, 000

## COMMERCIAL STATISTICS.

The commerce involved and interested in this improvement includes that of all the ports of the St. Lawrence River from Lake Ontario to the sea.

## T T 9.

## IMPROVEMENT OF HARBOR AT OGDENSBURG, NEW YORK.

## REPORT OF OPERATIONS.

Dredging of channels was begun October 2, 1902, under contract with the Daly & Hannan Dredging Company and continued during the remainder of the fiscal year, except during the winter months.

The city front channel, the channel along the wharves in the lower harbor, and the lower entrance channel were dredged where necessary, and a turning basin dredged in front of the wharf between Franklin and Elizabeth streets to allow the largest boats on the St. Lawrence River to turn.

The dredging of these channels was completed in May, 1903; 47,775 cubic yards of soft material and 3,755 cubic yards of hardpan and bowlders were removed. The depths made were 15 feet along the city front and the wharves in the lower harbor and 16 feet in the lower entrance channel, all below zero of Oswego gauge.

From the channel in the mouth of the Oswegatchie River there had been removed 15,224 cubic yards of hardpan and bowlders, making the channel 75 to 100 feet wide and 15 feet deep, below the zero of Oswego gauge. Work was in progress in this channel at the close of the fiscal year and it will not be fully completed before August, 1903.

#### PROPOSED OPERATIONS AND REMARKS.

This harbor fills up with sand and silt and requires frequent dredging to maintain the depth of the project.

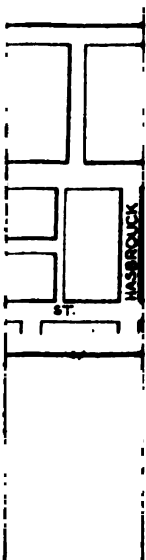
It is estimated that there will be required to June 30, 1905, for dredging and office and engineering expenses, \$20,000, and I recommend that this amount be appropriated.

#### *Money statement.*

July 1, 1902, balance unexpended .....	\$20,042. 29
June 30, 1903, amount expended during fiscal year .....	14,471. 91
July 1, 1903, balance unexpended .....	5,570. 38
July 1, 1903, amount covered by uncompleted contracts .....	4,195. 25
Amount that can be profitably expended in fiscal year ending June 30, 1905, for maintenance of improvement, in addition to the balance unexpended July 1, 1903.....	
Submitted in compliance with requirements of sundry civil act of June 4, 1897, and of section 7 of the river and harbor act of 1899.	20,000. 00

#### APPROPRIATIONS AND ALLOTMENTS.

August 30, 1852 .....	\$3,000. 00
March 2, 1867 .....	40,000. 00
July 17, 1870 .....	15,000. 00
March 3, 1871 .....	25,000. 00
June 10, 1872 .....	10,000. 00
March 3, 1873 .....	6,000. 00
June 23, 1874 .....	6,000. 00
March 3, 1875 .....	5,000. 00
December 11, 1877 (from appropriation for "Repairs on Harbors on Northern Lakes") .....	5. 56
September 10, 1879 (from appropriation for "Examinations, Surveys, and Contingencies of Rivers and Harbors") .....	300. 00
July 26, 1880 (from appropriations for "Examinations, Surveys, and Contingencies of Rivers and Harbors") .....	50. 00
August 2, 1882 .....	10,000. 00
July 3, 1884 .....	15,000. 00
August 5, 1886 .....	10,000. 00
August 11, 1888 .....	15,000. 00





September 19, 1890 .....	\$42,000.00
July 13, 1892 .....	40,000.00
August 18, 1894 .....	20,000.00
June 3, 1896 .....	20,000.00
March 3, 1899 .....	15,000.00
June 13, 1902 .....	20,000.00
<b>Total</b> .....	<b>317,355.56</b>

## CONTRACTS IN FORCE.

*Contract for dredging in Ogdensburg Harbor, New York, dated September 29, 1902.*

Name of contractor: Daly & Hannan Dredging Company, Ogdensburg, N. Y.

Rates:

Dredging hardpan and boulders, per cubic yard, 39 $\frac{1}{2}$  cents.

Dredging sand and other material, per cubic yard, 18 cents.

Date of approval: October 13, 1902.

Date of commencement: October 13, 1902.

Date of expiration: November 30, 1903.

## COMMERCIAL STATISTICS.

*Arrivals and departures of vessels for the year ending December 31, 1903.*

Vessels.	Arrivals from—				Departures to—			
	Home ports.		Foreign ports.		Home ports.		Foreign ports.	
	No.	Tons.	No.	Tons.	No.	Tons.	No.	Tons.
Steam .....	693	297,868	767	67,604	722	301,496	736	62,494
Sail and barges .....	91	32,461	180	53,055	153	56,166	118	32,755
<b>Total</b> .....	<b>784</b>	<b>330,329</b>	<b>947</b>	<b>120,659</b>	<b>885</b>	<b>357,662</b>	<b>854</b>	<b>95,249</b>

Total arrivals and departures (tonnage, 903,899) .....	3,470
Decrease of tonnage, 1902 under 1901 .....	13,768
Amount of revenue collected on water transportation, year ending December 31, 1902 .....	\$274,871
Value of imports by water, year ending December 31, 1902 .....	\$15,307,665
Value of exports by water, year ending December 31, 1902 .....	\$4,200,150
Greatest draft of vessels .....	16
Enrolled tonnage, port of Ogdensburg .....	24,530

*Receipts and shipments by water, year ending December 31, 1902.*

[Net tons.]

Articles.	Receipts.	Shipments.
Coal, anthracite .....	13,896	.....
Coal, bituminous .....	243,731	118,475
Wheat .....	39,999	44,266
Corn .....	82,259	
Oats .....	8,844	
Barley .....	192	
Lumber .....	215,200	1,446
Merchandise, etc. ....	68,717	
<b>Total</b> .....	<b>672,838</b>	<b>164,187</b>

Record incomplete. There is a quantity of merchandise and lumber received and coal shipped by ferry across the St. Lawrence River to Prescott, Ontario, of which collector of customs at Ogdensburg furnished no record.

Foreign merchandise to the value of \$20,000,000 is received and shipped by water and rail annually, passing through the custom-house at Ogdensburg. The relative amounts of this merchandise carried by vessels and railroads and its classification and tonnage can not be obtained from the custom-house records.

About 200,000 passengers arrive and depart by water annually.

## T T 10.

## IMPROVEMENT OF ST. LAWRENCE RIVER AT THE HEAD OF LONG SAULT ISLAND.

A description of the locality and a discussion of the project for the work is printed with map in House Document No. 201, Fifty-sixth Congress, second session, and in Report of the Chief of Engineers for 1901, without map, pages 3389 et seq.

The first appropriation for this work, made in the river and harbor act of June 13, 1902, is as follows:

Improving Saint Lawrence River at the head of Long Sault Island in accordance with the report submitted in House Document Numbered Two hundred and one, Fifty-sixth Congress, second session, forty-eight thousand dollars: *Provided*, That no part of said amount shall be expended until the Saint Lawrence River Power Company shall have filed with the Secretary of War an agreement in writing that their canal from the Saint Lawrence River to Massena may be used for all purposes of navigation free from tolls or charges, and to the effect that if in the future a waterway connecting said canal with Grasse River shall be undertaken by the Government, such locks and dams in said canal as may be necessary may be constructed by the Government and authority be given to enter upon and use sufficient land for the construction and operation of such locks and dams without cost.

## REPORT OF OPERATIONS.

The St. Lawrence River Power Company having notified this Office by letter of October 1, 1902, that the company had decided not to take advantage of the conditions prescribed by the act of June 13, 1902, but to do the proposed work at its own expense, the matter was reported to the Chief of Engineers and a decision asked for as to whether the said company would require permission to do the work as provided in section 1, river and harbor act approved June 13, 1902. Decision received back that none of the appropriation could be expended under existing conditions, and that further action must be deferred until the matter is acted upon by Congress.

The St. Lawrence River Power Company having renewed its application to perform the proposed work at its own expense, this application was forwarded with a report and recommendations on February 17. The Secretary of War approved the plans and authorized the St. Lawrence River Power Company to dredge the proposed channel March 20, 1903, under the provisions of section 1, river and harbor act of June 13, 1902.

*Money statement.*

July 1, 1902, balance unexpended .....	\$48,000.00
July 1, 1903, balance unexpended .....	48,000.00

## APPROPRIATION.

June 13, 1902 .....	\$48,000.00
---------------------	-------------

## T T II.

## REMOVING SUNKEN VESSELS OR CRAFT OBSTRUCTING OR ENDANGERING NAVIGATION.

Supplement No. 2 to Bulletins 12A, 12B, 12C, 12D, and 12E, Survey of Northern and Northwestern Lakes, and Notice to Mariners, No. 37, September 13, 1902, having stated that "a sunken vessel lies about 2 miles west and 1 mile north from Braddock Point Light Station, Lake Ontario," an investigation was made by this Office, and it was found that it was an anchored spar so far inshore as not to be a menace to navigation.

This was reported to the Chief of Engineers November 11, 1902, and a recommendation made that nothing further be done about it.

The expense of the examination, \$8.02, was paid from an allotment made November 15, 1902, and the matter was closed.

There were no other operations during the year.





## APPENDIX U U.

---

### IMPROVEMENT OF RIVERS AND HARBORS IN CALIFORNIA SOUTH OF SAN FRANCISCO.

---

*REPORT FOR THE FISCAL YEAR ENDING JUNE 30, 1903, WITH OTHER  
DOCUMENTS RELATING TO THE WORKS. OFFICERS IN CHARGE,  
CAPT. EDGAR JADWIN AND MAJ. J. H. WILLARD, CORPS OF ENGI-  
NEERS.*

#### IMPROVEMENTS.

- |   |  |
|---|--|
| 1. San Diego Harbor, California.                      | 3. Wilmington Harbor, California.      |
| 2. Deep-water harbor at San Pedro Bay,<br>California. | 4. San Luis Obispo Harbor, California. |
- 

UNITED STATES ENGINEER OFFICE,  
*Los Angeles, Cal., July 11, 1903.*

GENERAL: I have the honor to transmit herewith annual report on works of river and harbor improvement in my charge for the fiscal year ending June 30, 1903.

Very respectfully, your obedient servant,

J. H. WILLARD,  
*Major, Corps of Engineers.*

Brig. Gen. G. L. GILLESPIE,  
*Chief of Engineers, U. S. A.*

---

## U U 1.

### IMPROVEMENT OF SAN DIEGO HARBOR, CALIFORNIA.

During the fiscal year no work has been done and no increased depth on the bar, due to scour, has been obtained, approximately 22 feet being the maximum draft that can be carried over the shoalest part of the bar at the entrance to the harbor. The depth of water in the middle-ground channel inside the entrance has increased to 17 feet during the year; a much deeper channel around the middle ground follows the westerly shore.

The erosion along the westerly extremity of North Island has continued during the year. Some erosion has also been noticed on the ocean beach opposite Spanish Bight, about  $1\frac{1}{4}$  miles to the eastward of the jetty.

Appropriations for completing the project have been made by river and harbor act of June 13, 1902, and by sundry civil act of March 3, 1903, amounting to \$267,850.

# 2172 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

A contract for the completion of the jetty has been made with A. E. Babcock, of Coronado, Cal., at \$1.85 per short ton of stone. The contractor has begun the construction of a single-track trestle from the shore to the end of the completed jetty, a distance of 4,595 feet. From this point on, a double-track trestle over the site of the jetty will be constructed. At the close of the fiscal year 1,050 feet of single track had been constructed and the work of opening the quarry had been commenced.

A contract for dredging 122,800 cubic yards of material on the outer bar was entered into with A. A. Polhamus, of San Diego, Cal., at 28½ cents per cubic yard, scow measurement, material to be dumped at sea. This is expected to deepen the bar to a depth of 26 feet at mean lower low water over a width of about 500 feet. A new suction dredge, with 12-inch discharge pipe, and hopper barges have been built by the contractor, and dredging is expected to begin early in July.

It is expected to advance the jetty and dredging simultaneously, in order that the increased current induced by the extension of the jetty will be better confined to the bar channel, and do less scouring elsewhere to the detriment of its power for maintenance of the channel in after years.

Surveys and many current observations on the outer bar and middle ground were made during the year.

## Money statement.

July 1, 1902, balance unexpended .....	\$76, 717. 80
Amount appropriated by sundry civil act approved March 3, 1903 .....	192, 850. 00
	<hr/>
	269, 567. 80
June 30, 1903, amount expended during fiscal year .....	3, 791. 72
	<hr/>
July 1, 1903, balance unexpended .....	265, 776. 08
July 1, 1903, outstanding liabilities .....	42. 40
	<hr/>
July 1, 1903, balance available .....	265, 733. 68
	<hr/>
July 1, 1903, amount covered by uncompleted contracts .....	235, 000. 00

## AMOUNT AND DATE OF ALL APPROPRIATIONS FOR THE WORK SINCE 1875.

March 3, 1875 .....	\$80, 000	June 3, 1896 .....	\$50, 000
March 3, 1879 .....	1, 000	March 3, 1899 .....	65, 000
August 11, 1888 .....	1, 000	June 13, 1902 .....	75, 000
September 19, 1890 .....	60, 500	March 3, 1903 .....	192, 850
July 13, 1892 .....	50, 000		
August 18, 1894 .....	50, 000	Total .....	625, 350

## ABSTRACT OF ALL CONTRACTS IN FORCE.

### Contract for dredging on outer bar.

Name of contractor: A. A. Polhamus.  
Rate: 28½ cents per cubic yard.  
Date of approval: December 4, 1902.  
Date of beginning work: July 10, 1903.  
Date of expiration: November 13, 1903.

*Contract for completing jetty.*

Name of contractor: A. E. Babcock.  
 Rates: \$1.85 per ton, of 2,000 pounds, of stone.  
 Date of approval: April 18, 1903.  
 Date of beginning work: June 26, 1903.  
 Date of expiration: December 26, 1904.

## COMMERCIAL STATISTICS FOR THE YEAR ENDING DECEMBER 31, 1902.

[Furnished by the collector of customs at San Diego, Cal.]

	Incoming.	Outgoing.
<b>Vessels:</b>		
Steam.....	183	188
Sailing.....	50	33
<b>Total.....</b>	<b>233</b>	<b>216</b>
<b>Tonnage.....</b>	<b>94,342</b>	<b>10,759</b>
Draft, greatest.....feet..	23	22
Merchandise, general.....tons..	15,436	9,488
Coal.....do.....	26,126	463
Cement.....do.....	12,380	87
Lumber.....feet..	20,200,000	888,347

Total amount of freight entered and cleared in 1902, 105,101 tons, a decrease of 13 per cent from the preceding year.

No lines of transportation have been established or abandoned during the year.

## U U 2.

## DEEP-WATER HARBOR AT SAN PEDRO BAY, CALIFORNIA.

The construction of the breakwater was continued during the year, under contract dated June 7, 1900, with the California Construction Company, of San Francisco, Cal.

At the beginning of the fiscal year 645,149 tons of substructure stone had been delivered, 4,016 feet of the substructure at its westerly end had been practically completed, and stone had been deposited for a distance of 350 feet farther.

During the year 149,274 tons of sandstone from Chatsworth Park quarry was placed in the hearting of the substructure and covered with 324,360 tons of granite from Declez quarry, a total for the substructure of 473,634 tons; the practically completed substructure has been extended 1,699 feet, or to a distance of 5,715 feet from its westerly end, and stone has been deposited for a distance of 350 feet farther; 95 bents, or 1,513 feet, of double-track trestle has been built, and 21,242 tons of granite from Casa Blanca quarry has been delivered and placed in the superstructure. The superstructure was begun at a distance of 632 feet from the westerly end of the breakwater, and has been extended eastward a distance of 678 feet on the ocean side and 735 feet on the harbor side.

At the beginning of the fiscal year the contractors were behind the requirements of the specifications in amount of stone delivered; this deficiency has been made up, and at the close of the year they are about two months in advance of the requirements.

Enough breakwater already has been constructed to serve as a partial protection in stormy weather.

# 2174 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

The total amount expended on this work to June 30, 1903, is \$959,436.92.

The available balance, together with any additional appropriations, should be expended in extending the breakwater under contract and for contingencies.

## Money statement.

July 1, 1902, balance unexpended .....	\$533, 546. 61
Proceeds sale of condemned engineer property .....	.05
Amount appropriated by sundry civil act approved March 3, 1903.....	500, 000. 00
	<hr/>
June 30, 1903, amount expended during fiscal year .....	1, 033, 546. 66
	421, 454. 29
	<hr/>
July 1, 1903, balance unexpended .....	612, 092. 37
July 1, 1903, outstanding liabilities .....	40, 573. 75
	<hr/>
July 1, 1903, balance available .....	571, 518. 62
	<hr/>
July 1, 1903, amount covered by uncompleted contracts.....	1, 664, 627. 42
	<hr/>
{ Amount (estimated) required for completion of existing project .....	1, 093, 108. 85
{ Amount that can be profitably expended in fiscal year ending June	
{ 30, 1905, in addition to the balance unexpended July 1, 1903.....	500, 000. 00
{ Submitted in compliance with requirements of sundry civil act of	
{ June 4, 1897.	

## AMOUNT AND DATE OF ALL APPROPRIATIONS FOR THE WORK.

June 3, 1896.....	<sup>a</sup> \$50, 000. 00
July 1, 1898.....	400, 000. 00
March 3, 1899.....	200, 000. 00
March 3, 1901.....	148, 000. 00
June 28, 1902.....	311, 085. 00
March 3, 1903.....	500, 000. 00
	<hr/>
Total .....	1, 607, 085. 00
Received from sale of property .....	.05
	<hr/>
Total .....	1, 607, 085. 05

## ABSTRACT OF ALL CONTRACTS IN FORCE.

### Contract for construction of breakwater.

Name of contractor: California Construction Company.

Rates:

For substructure stone, \$0.884 per ton of 2,240 pounds.

For superstructure stone, \$3.10 per ton of 2,240 pounds.

For concrete, \$6 per cubic yard.

Date of approval: June 27, 1900.

Date of beginning work: August 4, 1900.

Date of expiration: Indefinite, depending on appropriations made by Congress.

## COMMERCIAL STATISTICS FOR YEAR ENDING DECEMBER 31, 1902.

For commercial statistics see report of Wilmington Harbor, California.

<sup>a</sup> Of the appropriation of \$50,000 made by river and harbor act of June 3, 1896, for deep-water harbor at Santa Monica Bay, or San Pedro Bay, California, \$35,555.76 was expended by the Board provided for by said act. For the full report of the Board, with its accompanying documents, see Senate Document No. 18, Fifty-fifth Congress, first session.

## U U 3.

## IMPROVEMENT OF WILMINGTON HARBOR, CALIFORNIA.

The river and harbor act of June 13, 1902, appropriated \$250,000 for improving this harbor, the work to consist of dredging a channel 20 feet deep and 400 feet wide from the ocean to the lower end of the wharves, to 24 feet depth between harbor lines from the lower to the upper end of the wharves, and a turning basin 1,600 feet in diameter between the upper end of the wharves and the lower end of Mormon Island; the repair of the east jetty; and the construction of a dike to divert the water of the Los Angeles River from flowing into the harbor. The construction or purchase of a suitable dredge was also authorized. The \$50,000 appropriated by river and harbor act of June 3, 1896, was also made available for this work.

On October 2, 1902, an agreement was made with F. D. Lanterman for the repair of the east jetty at a point directly behind the wharf of the Salt Lake Railroad Company, as shown on the accompanying map. This work was completed November 21, 1902, at a cost of \$3,564.69; 1,563.46 tons of stone was delivered, at a cost of \$2.28 per ton, and 320 feet of jetty was repaired.

On November 24, 1902, a contract was entered into with Raymond A. Perry, of Oakland, Cal., for \$100,000 worth of dredging, to be distributed over localities where it was thought the greatest benefit to commerce would at once accrue. This work was urgently needed, as the commerce of the harbor was far in advance of the accommodations.

Owing to the difference in character of the material to be handled, the work was divided into two divisions. Division A comprises the dredging for 1,400 feet of the channel at the entrance of the harbor. Material here consists of a stiff dark mixture of clay and sand, having an odor of petroleum, beds of cobble, and fragmental rock. The contract calls for the dredging of 120,000 cubic yards of material, at a cost of 50 cents per cubic yard. Work was begun February 21, 1903, with a hydraulic cutter dredge, having 20-inch suction and discharge, and continued at different intervals for a total of forty-eight days; 19,146 cubic yards was removed and placed behind a new bulkhead built by the Southern Pacific Railroad Company from the southerly end of their wharf to the angle in the west jetty. On account of the hard material and the swell at the entrance, it was found impracticable to continue work in this division with the hydraulic dredge, and work has been suspended until a dipper dredge can be procured. Little or no benefit to commerce has been derived from the dredging so far accomplished in this division, as no cut was carried through to deep water.

Over the area dredged, as shown on the accompanying map, the average cut was 3.6 feet, and the bottom was lowered to a mean depth of 20.2 feet below mean lower low water.

Work in division B was begun March 16, and continued until the close of the fiscal year, except when dredging was in progress in division A, and with only slight delays on account of repairs; 104,589 cubic yards of material was removed, consisting principally of sand and soft mud, but also containing shells, old junk, and a few cobbles. Of the material removed, 63,016 cubic yards was placed behind the new bulkhead of the Southern Pacific Railroad Company, 27,854 cubic yards on Terminal Island above high water, and the remainder on Smiths Island.

The areas dredged in division B are shown on the accompanying map. In front of the wharves the channel is dredged to a depth of 20 feet, and the approaches to the wharves to a depth of 16 feet. The cuts varied in depth from 1 to about 14 feet.

During the year plans and specifications were made for the construction of a suction dredge to be operated by the Government, and proposals for the construction of same were invited by advertisement of June 24, 1903.

The total amount expended to June 30, 1903, is \$978,418.14.

The available channel depth has increased to 15.6 feet, which is the maximum draft that can be carried, at mean lower low water, over the shoalest part of the bar at the entrance to the harbor.

The available balance, together with any additional appropriations should be expended in the construction and operation of the dredge.

### *Money statement.*

July 1, 1902, balance unexpended .....	\$300,502.32
June 30, 1903, amount expended during fiscal year .....	23,920.46
July 1, 1903, balance unexpended .....	276,581.86
July 1, 1903, outstanding liabilities .....	9,676.08
July 1, 1903, balance available .....	266,905.78
July 1, 1903, amount covered by uncompleted contracts .....	76,323.29
{ Amount (estimated) required for completion of existing project .....	249,497.68
{ Amount that can be profitably expended in fiscal year ending June 30, 1905, in addition to the balance unexpended July 1, 1903 .....	75,000.00
{ Submitted in compliance with requirements of sundry civil act of June 4, 1897.	

### AMOUNT AND DATE OF ALL APPROPRIATIONS FOR THE WORK.

March 3, 1871 .....	\$200,000	July 5, 1884 .....	\$50,000
June 10, 1872 .....	75,000	August 5, 1886 .....	75,000
March 3, 1873 .....	150,000	August 11, 1888 .....	90,000
March 3, 1875 .....	30,000	September 19, 1890 .....	34,000
June 18, 1878 .....	20,000	July 13, 1892 .....	51,000
March 3, 1879 .....	12,000	June 3, 1896 .....	50,000
June 14, 1880 .....	35,000	June 13, 1902 .....	250,000
March 3, 1881 .....	33,000		
August 2, 1882 .....	100,000	Total .....	1,255,000

### ABSTRACT OF ALL CONTRACTS IN FORCE.

#### *Contract for dredging.*

Name of contractor: Raymond A. Perry.

Rates:

In division A, 50 cents per cubic yard.

In division B, 16 cents per cubic yard.

Date of approval: December 11, 1902.

Date of beginning work:

In division A, February 14, 1903.

In division B, March 16, 1903.

Date of expiration:

In division A, October 14, 1903.

In division B, November 26, 1903.

SC

a

1

2

11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60  
61  
62  
63  
64  
65  
66  
67  
68  
69  
70  
71  
72  
73  
74  
75  
76  
77  
78  
79  
80  
81  
82  
83  
84  
85  
86  
87  
88  
89  
90  
91  
92  
93  
94  
95  
96  
97  
98  
99  
100





## COMMERCIAL STATISTICS FOR THE YEAR ENDING DECEMBER 31, 1902.

[Furnished by the collector of customs at Los Angeles, Cal.]

	Incoming.	Outgoing.
<b>Vessels:</b>		
Steam.....	668	668
Sailing.....	297	297
<b>Total.....</b>	<b>965</b>	<b>965</b>
<b>Tonnage.....</b>	<b>576,334</b>	<b>18,814</b>
Draft, greatest.....feet..	19.5	19.5
Merchandise, general.....tons..	17,398	18,394
Lumber.....feet..	279,467,983	.....
Crude oil.....barrels.....	.....	82,516

Total amount of freight entered and cleared in 1902, 596,148 tons, an increase of 22 per cent over the preceding year.

No lines of transportation have been established or abandoned during the year.

## REPORT OF MR. R. A. CRAWFORD, ASSISTANT ENGINEER.

SAN PEDRO, CAL., July 6, 1903.

MAJOR: I have the honor to submit a report of operations covering the improvement work in harbor of Wilmington, Cal., during the fiscal year ending June 30, 1903.

The work comprised care of plant, repair of east jetty, dredging, surveys, and designing a dredge suitable for handling the general run of material to be found in this district.

*Plant.*—The plant and property belonging to this work were given proper care and attention.

*Repair of east jetty.*—The old wooden single work for 260 feet south of the point where the San Pedro, Los Angeles and Salt Lake Railroad tracks cross it, near lower end of Terminal Island, being in an advanced stage of decay, and the adjoining 60 feet of stone jetty on the south considerably below grade, an agreement was made with F. D. Lanterman, October 2, to reenforce it with a stone fill on both sides, the east side to have a width of 5 feet on top with an outer slope of 1 on 2, and the west side to have a width of 3 feet on top with a side slope of 1 on 1½. Work was begun October 17 and completed November 21; 1,563.46 tons of stone were delivered in accordance with the terms of the agreement, covering a total of 320 linear feet, as shown on accompanying map.

*Dredging.*—Under the approved project for dredging the inner harbor, a formal contract was entered into with Ramond A. Perry, November 24, 1902, for \$100,000 worth of dredging to be distributed over localities where the greatest benefit to commerce would at once accrue. Owing to the difference in character of the materials to be handled the work was classed under two divisions with a view to separating the harder from the easier dredging and obtaining a price per cubic yard for the removal of each kind, as there was a much larger percentage of the latter than the former.

Division A comprises the hard dredging, and extends 1,400 linear feet south from a line normal to the project lines and distant 600 feet north from a line parallel to it and passing through the Coast and Geodetic Survey station on Deadmans Island. In Division B the easier dredging is found, and this comprises everything north of the above-described north line of Division A. The line separating these two divisions was determined by borings.

According to the terms of the contract, \$60,000 is to be expended in Division A, and the price for the removal of the material is 50 cents per cubic yard. In Division B \$40,000 is to be expended, at a cost of 16 cents per cubic yard. Work was begun February 21 in Division A by the dredge *Olympian*, a hydraulic cutter dredge with 20-inch suction and discharge, and continued at different intervals for a total of forty-eight days. On account of the hard materials encountered, consisting principally of stiff, dark mixture of clay and sand having a petroleum odor, beds of cobbles, and a few fragmental rock; also, on account of several delays caused by collisions with passing vessels and breaking spuds, very slow progress was made. On May 17, after

having broken five spuds in trying to hold the dredge in a working position, due to excessive swell and strong tides, permission was granted the contractor temporarily to suspend operations in this division, upon a statement from him that a dredge more suitable for the work in hand had been procured and would begin operations early in July. In the meantime the *Olympian* was to push to completion the work outlined in Division B.

There were removed in Division A 19,146 cubic yards of material, all of which was placed behind the new bulkhead of the Southern Pacific Railroad Company. Little or no benefit to commerce has been derived from the dredging so far accomplished in this division, as no cut was continuously carried through. Over the area dredged, as shown on accompanying map, the bottom was lowered a mean depth of 3.60 feet to a mean elevation of 20.2 feet below mean low water.

Work in Division B was begun March 16, and continued until the close of the fiscal year, except when dredging was in progress in Division A, with only such slight delays as arose on account of repairs; 104,589 cubic yards of material were removed, consisting principally of sand and soft mud, but containing shells, old junk, and a few cobbles. Of the material removed, 63,016 cubic yards were placed behind the new bulkhead of the Southern Pacific Railroad Company, 27,854 cubic yards on the bar adjoining Terminal Island, and the remainder on Smiths Island.

The areas dredged in Division B are shown on the accompanying map. The following table shows the extent of work in the several localities and what was accomplished:

Location of cut.	Length.	Width.	Least depth before dredging.	Greatest depth before dredging.	Mean depth before dredging.	Least depth after dredging.	Greatest depth after dredging.	Mean depth after dredging.	Mean cut.
Approach to wharf of S. P., L. A. & S. L. R. R.....	700	75	8.4	16.3	13.01	14.2	20.2	17.13	4.12
Along wharf of S. P., L. A. & S. L. R. R.....	900	100	7.7	16.3	13.73	19.2	23	21.14	7.41
Along wharf of S. P. R. R.....	200	75	17	19.5	17.82	18.3	21.2	20.14	2.32
Along wharfs of S. P. R. R. and Banning Co.....	1,100	75	6.1	17.9	15.09	18.1	21.9	20.13	5.04
Along wharf of Southern California Lumber Co. and approach.....	850	75	7.8	15.4	13.17	18.6	21.9	20.08	6.91
Along wharf of Crescent Coal Co.....	300	100	10.7	17.2	13.27	18.5	21.2	20.04	6.77
Approach to wharf of Crescent Coal Co.....	200	75	11.1	15.8	13.66	15.1	17.6	16.66	3.00
Along northern portion wharf San Pedro Lumber Co.....	830	75	10.2	17.5	14.88	18.4	22	20.53	5.65

The shoalest part of the entrance to the harbor at the close of the fiscal year was the hard lump in Division A in mid-channel west of the east jetty and about abreast of its southern extremity. The maximum draft that could be carried over this lump June 30 was 15.6 feet at mean low water; the usual variation of level of water surface for this locality is 5.1 feet.

*Surveys.*—A hydrographic survey extending from the entrance to the harbor to the upper end of the wharves was made in January for the purpose of allotting the amount of dredging that could be done in the different localities under the contract made with Raymond A. Perry.

*New dredge.*—In accordance with the approved project for the improvement of the harbor, which authorizes the purchase of a suitable dredge for continuing this work, proposals are being invited until July 24, 1903, on general plans designed in this office for furnishing and delivering at San Pedro, Cal., a hydraulic dredge with cutter, having a 20-inch suction and discharge, and capable on test of removing 500 cubic yards per hour of the average material to be found in the inner harbor; the dredge to be equipped with modern machinery and to have a machine shop in which all general repairs can be made.

Very respectfully, your obedient servant,

R. A. CRAWFORD,  
Assistant Engineer.

Maj. J. H. WILLARD,  
Corps of Engineers.

## U U 4.

## IMPROVEMENT OF SAN LUIS OBISPO HARBOR, CALIFORNIA.

A contract for continuing the construction of the breakwater under an appropriation of \$50,000 made by the river and harbor act of June 13, 1902, was entered into with A. A. Polhamus, of San Diego, Cal., at \$1.86 per ton, of 2,000 pounds, of stone. Work under this contract began April 25, 1903, but owing to the continued rough weather only 4,711 tons has been delivered. This stone was placed at the outer end of the breakwater, along a stretch 300 feet long, beginning at a point 700 feet from Whaler Island, and in such manner as to give as much protection as possible to the stone barges unloading alongside of the breakwater.

The total amount expended on the construction of this breakwater up to June 30, 1903, is \$231,312.48.

The available balance, together with any additional appropriations, should be expended in extending the breakwater under contract and for contingencies.

*Money statement.*

July 1, 1902, balance unexpended .....	\$51, 200. 94
Proceeds sale of condemned engineer property .....	. 95
	<hr/>
July 30, 1903, amount expended during fiscal year .....	51, 201. 89
	<hr/>
July 1, 1903, balance unexpended.....	48, 688. 47
July 1, 1903, outstanding liabilities .....	6, 710. 98
	<hr/>
July 1, 1903, balance available.....	41, 977. 49
	<hr/>
July 1, 1903, amount covered by uncompleted contracts.....	39, 503. 12
	<hr/>
{ Amount (estimated) required for completion of existing project .....	288, 660. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1905, in addition to the balance unexpended July 1, 1903.....	100, 000. 00
{ Submitted in compliance with requirements of sundry civil act of June 4, 1897.	

## AMOUNT AND DATE OF ALL APPROPRIATIONS FOR THE WORK.

August 11, 1888 .....	\$25, 000. 00
September 19, 1890 .....	40, 000. 00
July 13, 1892.....	30, 000. 00
August 18, 1894 .....	40, 000. 00
June 3, 1896 .....	40, 000. 00
March 3, 1899 .....	55, 000. 00
June 13, 1902 .....	50, 000. 00
	<hr/>
Total .....	280, 000. 00
Received from sale of property .....	. 95
	<hr/>
Total .....	280, 000. 95

## 2180 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

## ABSTRACT OF ALL CONTRACTS IN FORCE.

*Contract for continuing construction of breakwater.*

Name of contractor: A. A. Polhamus.  
 Rate: \$1.86 per ton, of 2,000 pounds, of stone.  
 Date of approval: March 20, 1903.  
 Date of beginning work: May 25, 1903.  
 Date of expiration: November 25, 1903.

## COMMERCIAL STATISTICS FOR THE YEAR ENDING DECEMBER 31, 1902.

[Furnished by the Pacific Coast Railway Company.]

	Incoming.	Outgoing.
<b>Vessels:</b>		
Steam .....	218	218
Sailing .....	2	2
<b>Total</b> .....	<b>220</b>	<b>220</b>
<b>Tonnage</b> .....	16,791	28,916
Draft, greatest .....	19	19
Merchandise, general .....	5,712	1,523
Coal .....	148	
Lumber .....	5,358,814	
Grain .....	197	34,771
Bituminous rock .....		2,163
Dairy products .....	17	457
Live stock .....	1	2

Total amount of freight entered and cleared in 1902, 55,707 tons, an increase of 36 per cent over that for 1901.

No lines of transportation have been established or abandoned during the year.

## APPENDIX V V.

### IMPROVEMENT OF RIVERS AND HARBORS IN CALIFORNIA TRIBUTARY TO AND NORTH OF SAN FRANCISCO BAY, AND OF PEARL HARBOR, HAWAII.

REPORT OF LIEUT. COL. W. H. HEUER, CORPS OF ENGINEERS, OFFICER  
IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1903, WITH  
OTHER DOCUMENTS RELATING TO THE WORK.

#### IMPROVEMENTS.

- |   |  |
|---|--|
| 1. Alviso Harbor, California.                                 | 8. Mokelumne River, California.                |
| 2. Redwood Creek, California.                                 | 9. Sacramento and Feather rivers, California.  |
| 3. San Francisco Harbor, California.                          | 10. Petaluma Creek and Napa River, California. |
| 4. Oakland Harbor, California.                                | 11. Humboldt Harbor and Bay, California.       |
| 5. San Pablo Bay, California.                                 | 12. Pearl Harbor, Hawaii.                      |
| 6. San Joaquin River, California.                             |  |
| 7. Rectification of Stockton and Mormon channels, California. |  |

#### HARBOR LINES.

13. China Basin and Mission Rock, San Francisco Harbor, California.

UNITED STATES ENGINEER OFFICE,  
*San Francisco, Cal., July 16, 1903.*

GENERAL: I have the honor to transmit herewith my annual report for the fiscal year ending June 30, 1903, for river and harbor works.

Very respectfully, your obedient servant,

W. H. HEUER,  
*Lieut. Col., Corps of Engineers.*

Brig. Gen. G. L. GILLESPIE,  
*Chief of Engineers, U. S. A.*

## V V I.

### IMPROVEMENT OF HARBOR AT ALVISO, CALIFORNIA.

A description and brief history of Alviso Slough is printed in the Annual Report of the Chief of Engineers for 1902, page 525.

\* \* \* \* \*

No work has been done in the past fiscal year.

## 2182 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

As neither commerce nor navigation has increased on the slough since the improvement was completed, and as the channel obtained seems sufficient for existing commerce, I consider Alviso Harbor and Slough at present unworthy of further improvement.

### *Money statement.*

July 1, 1902, balance unexpended .....	\$20, 456. 53
June 30, 1903, amount expended during fiscal year .....	144. 25
July 1, 1903, balance unexpended .....	20, 312. 28

### APPROPRIATIONS.

March 3, 1899.....	\$48, 000. 00
--------------------	---------------

### COMMERCIAL STATISTICS.

During the year 1902 the commerce on Alviso Slough was, if possible, smaller and more unimportant than in 1901, consisting principally of vegetables shipped to the San Francisco market. A small steamer, the *San Jose*, 192 tons, ran between San Francisco and Alviso during the greater portion of the year, but the venture proving unprofitable, it was taken off the route on January 4, 1903, and has not been run since. Scow schooners have at times made occasional trips into Alviso Slough, but no evidence of any such traffic during 1902 could be obtained.

## V V 2.

### IMPROVEMENT OF REDWOOD CREEK, CALIFORNIA.

The river and harbor act of June 13, 1902, provided as follows:

Improving Redwood Creek, California: Completing improvement in accordance with the report submitted in House Document Numbered Eighty-seven, Fifty-fourth Congress, second session, eight thousand four hundred dollars.

The report in the document above referred to provides for a sheet-pile dam about 300 feet in length across a navigable slough, a sheet-pile spur dike, estimated at about 600 feet in length, protected by a brush mat loaded with stone, and the dredging of a new channel, to have a depth of about 5 feet at low tide, through a middle ground bare at low water. Length and width of channel were not specified, but measured on the map the channel to be dredged would have a length of about 3,000 feet, the estimated volume of excavation was 24,000 cubic yards and some dredging in front of the wharf at Redwood City. The entire work was estimated to cost \$8,400.

On July 2, 1902, project for the expenditure of the money appropriated was submitted, which was approved July 17, 1902.

Survey of the locality where the dredged channel was to be made and a search of records showed that the submerged land on which the channel was to be cut was held in corporate ownership by the Morgan Oyster Company, which had purchased the same as swamp and overflowed lands from the State of California. Written consent was obtained from the owners of the property agreeing not to charge tolls

to any vessels using the channel, furnishing a free right of way to and authorizing the Government to cut such channel through the property as was contemplated in the report above referred to.

After the survey was completed and estimates were received it was thought that the funds available would not complete a channel of sufficient width and depth to be effective and, in addition thereto, to build the dam and dike referred to in the report. Further study showed it would be injudicious to build the dam across the navigable channel, as it would interfere with the free tidal movement necessary to maintain the channel it was proposed to dredge, and that the dike proposed at the lower end of the channel would not be necessary. Accordingly bids were invited for the dredging only and were opened on April 9, 1903. The following is an abstract of bids submitted:

	Per cubic yard.
Pacific Coast Dredging and Reclamation Company .....	cents.. 13
Atlantic Gulf and Pacific Company.....do.....	14. 90
Willis G. Witter .....	do.... 11

Contract was made with Willis G. Witter, which was approved June 2, 1903. The contractor began dredging in the latter part of May and by June 30, 1903, had completed a cut exceeding 100 feet in width and about 7 feet in depth at low water, though only required to furnish and only paid for a channel 100 feet in width and 5 feet in depth at low water. He then commenced, and is now engaged in, dredging in front of the city wharf near Redwood City. The total quantity of material dredged to June 30, 1903, was 44,882 cubic yards. The entire dredging will probably be completed early in July, 1903.

#### *Money statement.*

July 1, 1902, balance unexpended .....	\$8,400.00
June 30, 1903, amount expended during fiscal year .....	1,545.50
July 1, 1903, balance unexpended .....	6,854.44
July 1, 1903, amount covered by uncompleted contracts.....	5,075.74

#### APPROPRIATIONS.

July 5, 1884 .....	\$3,000
August 5, 1886 .....	5,000
August 11, 1888 .....	7,400
September 19, 1890 .....	8,000
June 13, 1902 .....	8,400
Total .....	31,800

#### CONTRACTS IN FORCE.

*Contract dated May 5, 1903, for dredging in Redwood Creek, California.*

Rate: 11 cents per cubic yard, place measurement.  
 Name of contractor: Willis G. Witter.  
 Date of approval: June 2, 1903.  
 Work to be commenced: July 7, 1903.  
 Work to be completed: October 7, 1903.

## 2184 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

### COMMERCIAL STATISTICS OF REDWOOD CREEK, CALIFORNIA.

The commerce of Redwood Creek is carried on scow schooners, which run regularly into the creek, and two small steamers, which make occasional trips. Steam schooners also at times take a load of bark into Redwood Creek. The following is a statement of the business done in 1902, as furnished by the shippers:

	Tons.
Lumber received and shipped.....	2, 048
Supplies for tannery received .....	8, 307
Tannery products shipped .....	928
Coal received .....	600
Hay and grain shipped .....	700
Salt shipped .....	3, 158
Total .....	15, 741

### V V 3.

### IMPROVEMENT OF HARBOR AT SAN FRANCISCO, CALIFORNIA.

This work consists of the removal of Arch rock, the two Shag rocks, and Blossom rock, which are or were located in the fairway of vessels in San Francisco Harbor.

Survey and estimates for the removal of these rocks is printed in the Annual Report of the Chief of Engineers for 1898, Part IV, page 2923.

By act of March 3, 1899, Congress appropriated \$100,000, and by act of June 6, 1900, appropriated an additional amount of \$170,000, for the removal of Arch rock and the two Shag rocks. By act of June 13, 1902, Congress amended the act of March 3, 1899, so as to include the removal of Blossom rock, and by act of March 3, 1903, Congress appropriated \$50,000 for continuing improvement by the removal of Blossom rock.

Contract for the removal of Arch rock and the two Shag rocks to a depth of 30 feet, for \$253,500, was made with Rudolf Axman, and was approved April 10, 1899. Shag rock No. 1 was removed by July 30, 1900, Shag rock No. 2 by April 5, 1901, and the removal of Arch rock was completed on April 30, 1903.

Contract for the removal of Blossom rock to a depth of 30 feet, for \$45,142, was made with Robert Wakefield, and approved on November 26, 1902.

At the beginning of the fiscal year July 1, 1902, the two Shag rocks had been completely removed and about 44 per cent of the area of Arch rock had been cleared to the grade plane. Dredging and surface blasting were continued on this rock until April 30, 1903, when, after repeated surveys and sweeping over the rock, it was found that the required 30 feet of depth below the mean of the lower low waters had been obtained. The contractor was about nine months longer in completing the whole work than was contemplated and required by the terms of the contract. The delay was not occasioned by the violence of the elements or by any fault on the part of the Government.

The contractor for the removal of Blossom rock began preparations and established a drilling scow over the rock during May, 1903. A few holes were drilled, loaded, and fired. The scow was then removed, and at present another small scow with a grappling tongs operated by



steam on board is anchored over the rock, prospecting with a view to determine how much of the rock is broken.

Blossom rock has a volume of 4,630 cubic yards above the 30-foot plane of depth, and the rate of rock removal required in the contract is at least 1,000 cubic yards per month. Work was required to be commenced on May 17 and to be completed on October 6, 1903. No rock worth mentioning has yet been removed.

During the fiscal year the sum of \$106,008.69 has been expended, making the total expenditure on the work of rock removal to June 30, 1903, \$267,769.99.

The supervision of the work has been under charge of Assistant Engineer H. L. Demeritt, and acknowledgment for faithful and efficient service is due him.

Acknowledgment is also due Capt. Aug. F. Rodgers, of the United States Coast and Geodetic Survey, for monthly returns of tide-gauge readings furnished for comparison with our own records.

#### *Money statement.*

July 1, 1902, balance unexpended .....	\$108, 238. 70
Amount appropriated by sundry civil act approved March 3, 1903 .....	50, 000. 00
	<hr/>
	158, 238. 70
June 30, 1903, amount expended during fiscal year.....	106, 008. 69
	<hr/>
July 1, 1903, balance unexpended .....	52, 230. 01
	<hr/>
July 1, 1903, amount covered by uncompleted contracts.....	45, 142. 00

#### CONTRACTS IN FORCE.

*Contract dated September 14, 1899, for removing rocks in San Francisco Harbor, California.*

[For \$258,500.]

Name of contractor: Rudolf Axman.  
Date of approval: September 29, 1899.  
Work commenced: December 3, 1899.  
Work completed: April 30, 1903.

*Contract dated November 14, 1902, for removing Blossom rock, San Francisco Harbor, California.*

[For \$45,142.]

Name of contractor: Robert Wakefield.  
Date of approval: November 28, 1902.  
Work commenced: May 17, 1903.  
Work completed: Work in progress.  
Work should be completed: October 6, 1903.

#### APPROPRIATIONS.

March 3, 1899.....	\$100, 000
June 8, 1900 .....	170, 000
March 3, 1903.....	50, 000
	<hr/>
Total .....	320, 000

## COMMERCIAL STATISTICS.

The following statement of the tonnage of commercial vessels arriving at the port of San Francisco during the year 1902 was furnished by the secretary of the San Francisco Merchants' Exchange:

	Tons.
From foreign ports .....	1, 353, 050
From domestic ports .....	1, 872, 642
Total .....	3, 225, 692

The above includes only commercial vessels and not the large number of United States and foreign Government vessels which visit this port. There are also a number of large ferryboats plying in San Francisco Harbor, carrying much freight and enormous numbers of passengers, and a large number of steam and sail boats carrying freight to the various landings on and adjacent to the bay.

## V V 4.

## IMPROVEMENT OF OAKLAND HARBOR, CALIFORNIA.

Details of original depth, width of channel, and commercial availability, together with the original project of 1874 and its modifications, are printed in the Annual Report of the Chief of Engineers for 1897, page 3327; and the history of the work, with projects and estimates made in accordance with the emergency river and harbor act of June 6, 1900, are printed in the Annual Report of the Chief of Engineers for 1901, page 3434.

During the fiscal year ending June 30, 1903, the sum of \$106,975.37 was expended, principally for dredging in the tidal canal, which work was completed on March 31, 1903.

Situated near the east end of the tidal canal was some property containing 2.7 acres claimed to be owned by Mrs. Emily G. Cohen, which was condemned in 1882 as belonging to A. A. Cohen, and payment of \$2,176 in accordance with the decree was made by the Government to the court. Some time thereafter the clerk of the court absconded with the funds. Until the last few years it was assumed that the Government had undisputed title to this piece of land. In October, 1901, while excavation of the tidal canal was in progress, the contractor, the engineer officer in charge, and others were enjoined from excavating on said property, on the ground that Mrs. Emily G. Cohen was the actual owner of the property, that the title was in her name, and that the property never had belonged to A. A. Cohen.

The United States district attorney and other attorneys for the defense, after a careful investigation of records, decided that the title was, and always had been, in the name of Emily G. Cohen; that A. A. Cohen never had owned the property, and that consequently the United States had no valid title thereto. Negotiations for acquiring the property were then entered into. The price asked was exorbitant. Condemnation proceedings were then authorized. Finally compromise was effected, and the property was purchased on February 11, 1903, for \$3,500, which was a trifle less than its assessed valuation. The injunction was then dissolved.

By act of June 13, 1902, Congress appropriated for—

Improving Oakland Harbor, California, in accordance with report submitted in House Document No. 262, Fifty-sixth Congress, second session, \$100,000: *Provided*, That a contract or contracts may be entered into by the Secretary of War for such

materials and work as may be necessary to prosecute said project, to be paid for as appropriations may from time to time be made by law, not to exceed in the aggregate \$150,000, exclusive of the amounts herein and heretofore appropriated.

The sundry civil act of March 3, 1903, appropriated for—

Improving harbor at Oakland, Cal.: For continuing improvement \$131,000.

House Document No. 262, above referred to, contained plans and estimates for three separate projects. No. 1 was estimated to cost \$646,293, No. 2 was estimated to cost \$1,687,818, and No. 3 was estimated to cost \$968,203. The projects and estimates are given in full in the document above referred to, and are also printed in the Annual Report of the Chief of Engineers for 1901, page 3448.

As Congress did not specify which one of the three projects was approved when project for expenditure of available funds was made, it was recommended to apply the funds appropriated to such part of the improvement as was common to all three projects. This was approved by the Secretary of War under date of July 17, 1902.

Bids were invited and opened on December 2, 1902, and contract was authorized and made with Warren H. Pomeroy, the lowest bidder, for dredging at 8.44 cents per cubic yard, place measurement, amounting to a little more than \$224,900. Contract was made December 27, 1902, and approved January 8, 1903. Work was begun February 17, 1903, by dredging between the jetties at the entrance to the harbor, and was continued until May 13, 1903, when all the excavation capable of being handled by the clam-shell dredge at that locality was removed. On June 25, 1903, dredging was resumed with a new hydraulic suction machine, which, in five days, to June 30, 1903, removed 5,000 cubic yards of very hard material.

The total excavated thus far, to June 30, 1903, in and near the jetty channel under the Pomeroy contract was 198,000 cubic yards, while the total excavated from the tidal canal during the year was 336,535 cubic yards.

The tidal canal is now completed, and contract, which will provide for the expenditure of very nearly all the money appropriated and available, has been made. This contract (if progress be maintained as required at a least rate of 100,000 cubic yards per month) will terminate in May, 1905. There are, therefore, funds enough available to carry the work as far as Congress has yet authorized and provided, probably to June 30, 1905.

Until it is known which of the three projects submitted Congress cares to adopt, further estimates for funds can not be made. The total amount expended on the entire work to June 30, 1903, was \$2,431,655.72.

At present the channel leading into Oakland Harbor is fully 300 feet bottom width, and part of the way 400 feet in width, and 20 feet in depth at low water from San Francisco Bay to Webster Street Bridge; thence a channel 200 feet wide and 6 feet deep to the tidal canal; thence a channel fully 300 feet in bottom width, nearly 400 feet top width, and 8 feet in depth through said canal into shallow water of San Leandro Bay.

The work has been in local charge of Assistant Engineer L. J. Le Conte and Junior Engineer J. A. Graham, both of whom have been attentive to their duties.

# 2188 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

## Money statement.

July 1, 1902, balance unexpended .....	\$225,919.65
Amount appropriated by sundry civil act approved March 3, 1903 .....	131,000.00
	<u>356,919.65</u>
June 30, 1903, amount expended during fiscal year .....	106,975.37
July 1, 1903, balance unexpended .....	<u>249,944.28</u>
July 1, 1903, amount covered by uncompleted contracts .....	<u>219,303.00</u>
{ Amount (estimated) required for completion of existing project, sufficient on hand until Congress specifies which project it desires to adopt.	

## APPROPRIATIONS.

June 24, 1874.....	\$100,000	July 13, 1892.....	\$150,000
March 3, 1875.....	100,000	August 18, 1894.....	100,000
August 14, 1876.....	75,000	June 3, 1896.....	20,000
June 18, 1878.....	80,000	June 4, 1897.....	200,000
March 3, 1879.....	60,000	July 1, 1898.....	133,000
June 14, 1880.....	60,000	March 3, 1899.....	133,000
March 3, 1881.....	60,000	June 6, 1900.....	180,000
August 2, 1882.....	200,000	June 13, 1902.....	100,000
July 5, 1884.....	139,600	March 3, 1903.....	131,000
August 5, 1886.....	60,000		
August 11, 1888.....	350,000	Total .....	2,681,600
September 19, 1890.....	250,000		

## CONTRACTS IN FORCE.

*Contract dated June 15, 1901, for dredging the tidal canal, Oakland Harbor, California.*  
*Rate: 19.74 cents per cubic yard.*

Name of contractor: Atlantic, Gulf and Pacific Company.  
Date of approval: August 29, 1901.  
Work commenced: September 1, 1901.  
Work completed: March 31, 1903.

*Contract dated December 27, 1902, for dredging in Oakland Harbor, California. Rate:*  
*8.44 cents per cubic yard.*

Name of contractor: Warren H. Pomeroy.  
Date of approval: January 8, 1903.  
Work commenced: February 17, 1903.  
Work completed: Still in progress.

## COMMERCIAL STATISTICS.

The following tabulated statements show the traffic by vessels and steamers which passed through the channel way between the jetties during the calendar year 1902.

The classified freight carried by the merchant vessels, embracing staple articles which entered this port of entry during the year, comprised:

	Tons.
Coal, wood, coke, and oil.....	168,162
Hay, grain, flour, etc.....	25,781
Lumber .....	143,420
Building materials.....	324,943
Sundries.....	40,210
Total .....	<u>702,516</u>

It is impossible to classify the miscellaneous freight transported by the several steam ferries, which during the year amounted to 3,128,263 tons, showing a decrease of 168,947 tons as compared with the preceding year.

The following table embraces gross statistics of general traffic passing through the jetty channel, both by sail and steam ferries, in 1902:

Traffic by ferries:	
Number .....	5
Trips .....	10,320
Passengers .....	180,760
Freight .....	tons.. 3,128,263
Traffic by vessels:	
Number .....	2,483
Freight .....	tons.. 702,516

### V V 5.

#### IMPROVEMENT OF SAN PABLO BAY, CALIFORNIA.

The project for the improvement of this bay contemplates obtaining by dredging a channel 300 feet wide, about 27,000 feet in length, and 30 feet deep at the mean of the lower low waters.

Congress, by act of June 13, 1902, appropriated for this work \$100,000, and authorized continuing contract for the completion of the work to a limit of \$381,000.

Project for the expenditure of the money appropriated was submitted June 26, 1902, and approved July 8, 1902.

Bids for doing the work by contract were invited, and opened on October 1, 1902. The bids ranged from 11.44 cents to 19.75 cents per cubic yard, place measurement. Contract was authorized and made with the lowest bidder under date of November 21, 1902. This contract was approved December 27, 1902. Work was required to be commenced on March 4, 1903, and to be completed on July 4, 1905. The rate of progress required was at least 100,000 cubic yards per month excavation, place measurement. The spoil is required to be placed behind suitable bulkheads near the south shore of the bay.

The contractor began work on February 24, 1903, and up to June 30, 1903, had removed and deposited only about 97,629 cubic yards of material from a cut about 2,000 feet long, from 100 to 140 feet in width, to 30 feet in depth; and from another cut about 2,500 feet long and 60 feet in width, but not yet clear to the required depth. This is only about 25 per cent of the monthly excavation or progress required by the terms of the contract.

At present the contractor's dredging plant is laid up for repairs and alterations, and the contractor states that he is having two very large light-draft dumping scows built, which are promised to be completed by the middle of July, and which, he states, will enable him to prosecute the work more vigorously.

Up to the present time no money for work done has been or can be paid the contractor. The contract makes monthly payments conditional on an average monthly output of at least 100,000 cubic yards. The contractor's existing plant is believed to be inadequate to the requirements of the contract, and it may be necessary in the near future to apply drastic measures to the contractor to enforce the requirements of the contract.

## 2190 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

### *Money statement.*

July 1, 1902, balance unexpended .....	\$100,000.00
Amount appropriated by sundry civil act approved March 3, 1903 .....	200,000.00
	<hr/>
June 30, 1903, amount expended during fiscal year .....	300,000.00
	2,120.16
July 1, 1903, balance unexpended .....	<hr/>
	297,879.84
July 1, 1903, amount covered by uncompleted contracts .....	<hr/>
	297,879.84
	<hr/>
{ Amount (estimated) required for completion of existing project .....	81,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1905, in addition to the balance unexpended July 1, 1903 .....	81,000.00
{ Submitted in compliance with requirements of sundry civil act of June 4, 1897.	

### APPROPRIATIONS.

June 13, 1902 .....	\$100,000.00
March 3, 1903 .....	200,000.00

### CONTRACTS IN FORCE.

*Contract dated November 21, 1902, for dredging in San Pablo Bay, California.*

[For \$311,282.40.]

Name of contractor: Rudolf Axman.  
Date of approval: December 27, 1902.  
Work required to be commenced: March 4, 1903.  
Work required to be completed: July 4, 1905.  
Work in progress.

### V V 6.

#### IMPROVEMENT OF SAN JOAQUIN RIVER, CALIFORNIA.

A description of this stream, its original condition, and the plan for its improvement are given in the Annual Report of the Chief of Engineers for 1896, page 3189.

#### REPORT OF OPERATIONS FOR THE FISCAL YEAR ENDING JUNE 30, 1903.

In July, 1902, Stockton slough shoaled to such an extent by deposits coming down from Mormon slough as to seriously interfere with navigation. Emergency contract was made to dredge a channel through the shoals. Bids were opened on August 11, 1902, and contract was made at 8 cents per cubic yard, place measurement, on August 25. Dredging began August 29 and was completed September 29. A total of 62,236 cubic yards of material was excavated and placed on shore. The length of channel dredged was 4,150 feet, and the width was 100 feet, which was dug to a depth of 9 feet at low water.

The winter freshets of 1902 and 1903 brought down an immense quantity of detritus and refilled Stockton channel, which was dredged in September, 1902, throughout its entire length, the average height of fill being about 8 feet. Fortunately, on account of high river, there

was water enough on top of the bar to permit steamboats to drag over it; but all boats were delayed, and it became necessary to again invite proposals to dredge a channel through the bar.

Bids were opened on April 22, 1903, and contract was made with the Bay and River Dredging Company on April 23, 1903, at 8½ cents per cubic yard. The contractor began work on April 29, using two clam-shell machines, and on July 1, 1903, completed the work. The quantity dredged and placed on shore was 141,655 cubic yards. The dredged channel was 6,950 feet in length, 100 feet wide on bottom, and 9 feet deep at low water. Steamboats had no trouble after the dredges began work, as the shoalest part of the obstruction was removed first, and a channel 50 feet wide was first obtained, which was afterwards increased to 100 feet as time permitted.

The matter of finding a place to store the excavated material is becoming very serious. The banks on each side of the waterway are piled as high as clam-shell dredges can reach. Behind these banks the land on each side of the slough is highly cultivated, and the owners of the land will not permit suction or hydraulic dredges to pump a mixture of water and sand on the land to the injury and destruction of their crops.

Stockton channel during the past year has required more dredging than ever before and will continue to refill with sand until Mormon channel, from which the detritus comes, can be diverted into the San Joaquin River, through the Calaveras River, for which appropriation to the extent of \$100,000 has been made, but which can not be used until the right of way for the canal has been furnished free of expense to the United States. Efforts to get this right of way have been made, and the legislature of California has appropriated \$60,000 for this purpose, but the owners of some of the lands are asking very large prices, and it is probable that the State will have to commence condemnation proceedings before all the land required can be obtained.

In the meantime navigation on Stockton slough must be maintained. The only available place now known where material can be deposited is on the flats on the borders of Mormon slough. As these flats are from 1 to 1½ miles distant from the center of Stockton slough, it means that the work can be done only by suction machines and that the rate per cubic yard for dredging (all of which will have to be impounded) in the future will considerably exceed that of the past.

The amount that has been expended on the work during the past fiscal year is \$13,461.32, and there is still due the contractor for work done in June and for retained payments on his contract the sum of \$6,408.21. This makes in round numbers an expenditure of about \$20,000 in the last ten months of the past fiscal year for dredging in Stockton channel alone.

It is almost certain that Stockton channel will again refill and that it will have to be dredged prior to June 30, 1904.

#### FUTURE OPERATIONS.

At present the channel is all that can be desired; but, judging by the annual filling that has occurred in the past few years, it will cost, for reasons stated above, something like \$30,000 to do the dredging required prior to June 30, 1904; and all that there is available for this purpose is \$14,828.02, and for the fiscal year ending June 30, 1905, at

# 2192 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

least another \$30,000 will be required, thus making a total estimate of \$46,000, in addition to what is on hand, as necessary for the maintenance of navigation on the San Joaquin River to June 30, 1905.

## Money statement.

July 1, 1902, balance unexpended .....	\$34,705.99
June 30, 1903, amount expended during fiscal year .....	13,469.76
July 1, 1903, balance unexpended .....	21,236.23
July 1, 1903, amount covered by uncompleted contracts .....	6,408.21
<hr/>	
{ Amount (estimated) required for completion of existing project .... Indeterminate.	
{ Amount that can be profitably expended in fiscal year ending June 30,	
{ 1905, in addition to the balance unexpended July 1, 1903 .....	
{ Submitted in compliance with requirements of sundry civil act of June	
{ 4, 1897. \$46,000.00	

## APPROPRIATIONS.

August 14, 1876 .....	\$20,000	July 13, 1892 .....	\$85,000
June 14, 1880 .....	20,000	August 18, 1894 .....	50,000
March 3, 1881 .....	40,000	June 3, 1896 .....	57,750
August 2, 1882 .....	40,000	March 3, 1899 .....	20,000
July 5, 1884 .....	20,000	June 13, 1902 .....	18,000
August 5, 1886 .....	18,750	Total .....	489,500
August 11, 1888 .....	25,000		
September 19, 1890 .....	75,000		

## CONTRACTS IN FORCE.

*Contract dated August 25, 1902, for dredging in Stockton channel, San Joaquin River, California.*

[Total cost, \$4,986.03.]

Name of contractor: Bay and River Dredging Company.

Work commenced: August 29, 1902.

Work completed: September 29, 1902.

*Contract dated April 23, 1903, for dredging in Stockton channel, San Joaquin River, California.*

[Total cost, \$12,040.68.]

Name of contractor: Bay and River Dredging Company.

Work commenced: April 29, 1903.

Work completed: July 1, 1903.

## COMMERCIAL STATISTICS.

The following is a statement of the freight and passengers carried on the San Joaquin River during the year 1902 by the boats of the California Navigation and Improvement Company and the Union Transportation Company, as reported by them:

### Lower San Joaquin River.

General freight .....	tons..	300,000
Passengers .....		76,208

### Upper San Joaquin River.

General freight .....	tons..	22,000
-----------------------	--------	--------



## V V 7.

## RECTIFICATION OF STOCKTON AND MORMON CHANNELS, CALIFORNIA.

The river and harbor act of June 13, 1902, provides for improvement of this locality in accordance with report printed in House Document No. 152, Fifty-fifth Congress, third session, and in the annual report of the Chief of Engineers for 1899, page 3189. The plan of improvement proposes the diversion of the waters of Mormon channel, to be accomplished by means of a dam to be located about 3 miles east of Stockton, and the construction of a canal 24,850 feet long, 150 feet wide at the bottom, thence to the north branch of Calaveras River, the estimated cost being \$255,016, which includes the cost of dredging in the river, purchase of right of way, changing of grades of highways and bridges, and dredging in Mormon and Stockton channels.

The act authorized the letting of a continuing contract in the sum of \$175,000, exclusive of the amount appropriated, for completing the project.

The act of June 13, 1902, required in its provisions "that the city of Stockton or the State of California shall first furnish to the United States the right of way for said canal." The legislature of the State of California, at its recent session, appropriated money with which to acquire the right of way above referred to.

No work has yet been done.

*Money statement.*

July 1, 1902, balance unexpended .....	\$50,000.00
Amount appropriated by sundry civil act approved March 3, 1903 .....	50,000.00
	<hr/>
July 1, 1903, balance unexpended .....	100,000.00
	<hr/>
{ Amount (estimated) required for completion of existing project .....	124,316.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1905, in addition to the balance unexpended July 1, 1903 .....	124,316.00
{ Submitted in compliance with requirements of sundry civil act of June 4, 1897.	

## V V 8.

## IMPROVEMENT OF MOKELUMNE RIVER, CALIFORNIA.

A description of this stream, with project for its improvement, work done, and commerce carried, is printed in the Annual Report of the Chief of Engineers for 1899, page 3168.

During the fiscal year ending June 30, 1903, no work has been done on the river, nor has any been done or urgently required since 1896. An examination of the river below New Hope landing and near the mouth of Snodgrass Slough for a bridge site was recently made by the engineer officer in charge of the river. There is a least depth of 3 feet at low water to New Hope landing, which is about 13½ miles above the mouth of the river. Between New Hope landing and Benson's bridge, about 4½ miles above, in which the existing low-water depth is about 2 feet, there are numerous snags and many overhanging trees, which, if again removed, would materially improve navigation. The estimated cost of this work is \$2,500. Occasional snagging on the river is necessary to maintain navigation.

*Money statement.*

July 1, 1902, balance unexpended .....	\$888.34
July 1, 1903, balance unexpended .....	888.34
July 1, 1903, outstanding liabilities .....	12.60
July 1, 1903, balance available .....	875.74
Amount (estimated) required for completion of existing project .... Indeterminate.	
Amount that can be profitably expended in fiscal year ending June 30,	
1905, in addition to the balance unexpended July 1, 1903 .....	2,500.00
Submitted in compliance with requirements of sundry civil act of June 4, 1897.	

## APPROPRIATIONS.

July 5, 1884 .....	\$8,500
August 5, 1886 .....	2,500
August 11, 1888 .....	2,000
July 13, 1892 .....	2,500
August 18, 1894 .....	2,500
Total .....	18,000

## COMMERCIAL STATISTICS.

During the year 1902 the commerce of the Mokelumne River was carried in two stern-wheel steamers, each of about 400-tons gross register, which made regular trips to New Hope Landing. The amount of freight reported to have been carried during the year was 43,299 tons. Some scow schooners also bring freight out of this river, but it has been impossible to obtain even an estimate of the amount carried.

*Comparative statement of commerce carried (general freight and grains).*

	Tons.		Tons.
1885 .....	42,000	1900 .....	86,989
1892 .....	44,241	1901 .....	81,701
1893 .....	47,000	1902 .....	43,299
1898 .....	52,771		

## V V 9.

## IMPROVEMENT OF SACRAMENTO AND FEATHER RIVERS, CALIFORNIA.

## REPORT OF BOARD OF ENGINEERS.

During the fiscal year ending June 30, 1903, a portion of the left bank of river at the Lovedal ranch near Freeport, some 12 miles below Sacramento, began caving just below one of the wing dams constructed in 1891. It became necessary to remedy this at once, and circulars were sent out to numerous contractors inviting bids for piles, brush, rock, and lumber to check the erosion and strengthen the wing dam. Emergency contract was made with Darby Laydon (the lowest bidder) on October 7, 1902, at the following rates: Piles at 23 cents per linear foot, driving same at \$9 each, rock in place at \$3.22 per ton, brush at \$1.75 per cubic yard, and lumber at \$25 per thousand feet, board measure.

Work was commenced on October 14 and completed on October 29, 1902. It consisted of driving a double row of piles, extending from the wing dam to below the center line of the caving bank; filling in between the piles with brush loaded with rock; then filling in between the line of piles and the bank with brush and loading the same with rock; sloping or grading the bank and building brush-mattress work, secured with lumber and ropes, for use as an apron, sunk by means of rock against the downstream side of piling.

The whole work cost \$3,277.76, and answered the purpose admirably.

On July 16, 1902, after making some minor repairs to the United States snag boat, she was started up river and kept in commission until November 12, 1902, cleaning out the whole river from its mouth up to Red Bluff, removing in this time 748 snags, firing 362 blasts containing 1,680 pounds of dynamite, built 658 linear feet of wing dam, cut and removed 84 overhanging trees from the banks, pulled 72 old piles near Freepoint ferry, and picked up and removed from mid-stream and placed on the bank the moorings of three flying ferries which were reported as obstructions to navigation, and which the owners, though notified more than a year before, failed to remove. While in commission the snag boat ran 1,324 miles. Daily gauge readings at various localities on the upper river have been continued.

The unexpended balance available for work on the lower Sacramento River (below Sacramento) on June 30, 1903, is \$53,749.60. The unexpended balance from the appropriation for improving Sacramento and Feather rivers, California, is \$10,445.84, practically all of which will be required in making extensive repairs to hull of snag boat, which have been authorized.

#### PRESENT CONDITION OF THE RIVER.

Below Sacramento there is a least channel depth of 7 feet at low water, which is all that was contemplated in the project of the Board of Engineers. The upper river has a 4-foot low-water depth from Sacramento to Colusa. From Colusa to Red Bluff efforts were made to obtain a least depth of 3 feet. This was found impracticable. About 26 inches was the best depth at low water that could be carried.

#### FUTURE OPERATIONS.

The lower river is in such satisfactory condition that no further appropriation is believed necessary. The unexpended balance available, \$53,749.60, is ample for any requirements in the near future. For the upper river the work of snagging and channel construction, for which the Board has estimated \$25,000, should be continued annually to maintain navigation. As only one appropriation of \$25,000 applicable to snagging (by act of June 13, 1902) has been made since the project for improvement was submitted, no snagging could be done in 1901, and none can be done in the season of 1903.

The river is now in bad condition on account of snags lodged there during the past winter, and navigation will be seriously impaired. The commissioner of public works of the State of California has allotted \$5,000 of State money and made a contract with private parties to remove some of the most dangerous snags from the upper river. This will relieve the situation to a very limited extent only.

# 2196 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

As the depths contemplated by the Board in the lower river have been obtained at a cost very much below the estimate, and as there appears to be no immediate use for further improvement in that portion of the river, it is recommended that the unexpended balance available for the lower river be made available for use for continuing improvement anywhere on the river between the head of navigation and the mouth of the river. The necessity for an annual appropriation for the upper river is urgent, and the Board recommends that some legislation be asked for for the purpose of securing uninterrupted work of operating snag boats on the Sacramento River for removing snags, wrecks, and other obstructions, and authorizing the Secretary of War, upon the application of the Chief of Engineers, to draw a warrant from time to time upon the Secretary of the Treasury for such funds as may be necessary to do such work, not to exceed \$25,000 per year, and that an itemized statement of said expenses accompany the annual report of the Chief of Engineers.

## Money statements.

### IMPROVING SACRAMENTO AND FEATHER RIVERS, CALIFORNIA.

July 1, 1902, balance unexpended .....	\$25,057.04
Amount received from sales of condemned property .....	73.80
	<hr/>
	25,130.84
June 30, 1903, amount expended during fiscal year .....	14,611.20
	<hr/>
July 1, 1903, balance unexpended .....	10,519.64
{ Amount (estimated) required for completion of existing project .....	Indeterminate.
{ Amount that can be profitably expended in fiscal year ending June 30, 1905, in addition to the balance unexpended July 1, 1903.....	25,000.00
{ Submitted in compliance with requirements of sundry civil act of June 4, 1897.	

### IMPROVING SACRAMENTO RIVER, CALIFORNIA.

July 1, 1902, balance unexpended .....	\$57,788.29
June 30, 1903, amount expended during fiscal year .....	4,039.38
	<hr/>
July 1, 1903, balance unexpended .....	53,748.91

### APPROPRIATIONS.

#### Sacramento and Feather rivers.

March 3, 1875 .....	\$15,000	August 11, 1888.....	\$20,000
June 18, 1878.....	15,000	September 19, 1890 .....	30,000
March 3, 1879 .....	20,000	July 13, 1892 .....	150,000
June 14, 1880.....	45,000	August 18, 1894.....	115,000
March 3, 1881 .....	60,000	June 13, 1902.....	25,000
August 2, 1882.....	250,000		
July 5, 1884.....	40,000	Total .....	785,000

#### Sacramento River.

March 3, 1899.....	\$30,000
June 6, 1900.....	60,000
	<hr/>
Total .....	90,000
	<hr/>
Aggregate.....	875,000

## CONTRACTS IN FORCE.

*Emergency contract dated October 7, 1902, for repairing wing dams in the Sacramento River, California.*

Name of contractor: Darby Laydon.  
 Work commenced: October 10, 1902.  
 Work completed: October 29, 1902.

## COMMERCIAL STATISTICS.

*Statistics of trade of the Sacramento and Feather rivers, California, for the year 1902.*

The following is the freight carried on the lower Sacramento River, below Sacramento:

	Tons.
By the boats of the Sacramento Transportation Company .....	85,348
By the boats of the Southern Pacific Company .....	151,382
By the boats of the California Transportation Company .....	59,477

Upper Sacramento River, above Sacramento:

	Tons.
From San Francisco and Sacramento to upriver points:	
Lumber .....	10,000
General merchandise .....	10,800
From upriver points to San Francisco:	
Hay .....	698
Broom corn .....	497
Wool .....	530
Dried fruit .....	375
Miscellaneous .....	2,950
From upriver points to Sacramento:	
Wood .....	3,154
Corn .....	964
Potatoes .....	2,150
Grain .....	1,656
Hogs and cattle .....	725
Miscellaneous .....	1,175

Grain shipments from upriver points to San Francisco, Port Costa, and Vallejo:

	Tons.
From Knights Landing to and above Colusa .....	33,739
From above Colusa to and including Butte City .....	19,131
From above Butte City to and including Jacinto .....	9,514
From above Jacinto to and including Chico Landing .....	6,221
From above Chico Landing to and including Tehama .....	3,640
From above Tehama .....	776

Total tonnage of the Sacramento for 1902 ..... 404,900

## V V 10.

## IMPROVEMENT OF PETALUMA CREEK AND NAPA RIVER, CALIFORNIA.

## (a) PETALUMA CREEK.

A description of this creek, its original condition, and project for improvement, with results obtained, will be found in the Annual Report of the Chief of Engineers for 1896, page 3205.

No work has been done during the past fiscal year. The depths obtained by dredging in this creek are not permanent. Winter floods annually cause the dredged channel to partially refill, and periodical dredging to maintain navigation becomes necessary.

A few years ago, at private expense, a canal about 3,000 feet in length and terminating in a basin was cut, connecting with the creek at a point about 1.2 miles below the extreme head of navigation. This basin and canal are free to all vessels desiring to use them, and are largely patronized. On the banks of the creek above the canal, however, there are several warehouses and manufacturing establishments. These are specially desirous that the dredged channel be maintained, as it permits of water transportation to their doors instead of draying to and from the basin referred to.

*Money statement.*

July 1, 1902, balance unexpended .....	\$3, 269. 93
July 1, 1903, balance unexpended .....	3, 269. 93
<hr/>	
(Amount (estimated). required for completion of existing project .....	Indetermi- nate.
Amount that can be profitably expended in fiscal year ending June 30, 1905, in addition to the balance unexpended July 1, 1903 .....	3, 000. 00
Submitted in compliance with requirements of sundry civil act of June 4, 1897.	

APPROPRIATIONS.

June 14, 1880 .....	\$8, 000	August 18, 1891 .....	\$15, 000
March 3, 1881 .....	8, 000	March 3, 1899 .....	4, 000
August 2, 1882 .....	14, 000	June 13, 1902 .....	3, 000
August 11, 1888 .....	2, 000		
September 19, 1890 .....	4, 000		
July 13, 1892 .....	10, 000	Total .....	68, 000

COMMERCIAL STATISTICS FOR PETALUMA CREEK AND NAPA RIVER, CALIFORNIA.

The following is a statement of the freight carried on Petaluma Creek by the steamer *Gold*, the only steamer plying on the creek, during 1902. A large amount of the heavier freight is also carried on scow schooners, which make frequent trips into this creek, but no statement of the amount can be obtained:

	Tons.
Butter and eggs .....	1, 891
Coal .....	1, 705
Lumber .....	1, 532
Fruit .....	718
Horses and cattle .....	1, 085
Hides and pelts .....	163
Laths and shingles .....	277
General merchandise .....	12, 652
Total .....	19, 223

Steamer, 1.  
Tonnage, 334.  
Trips by steamer, daily.  
Trips by schooners, daily.

(b) NAPA RIVER.

A description of this river, its condition, plans for improvement, and results obtained are printed in the Annual Report of the Chief of Engineers for 1896, page 3177.

An examination of and report on the river was made in August, 1902. No work has been done on the river during the past fiscal year. The depths obtained by dredging are not permanent, as annual freshets add detritus to the old and form new bars. The tidal range is from 5 to 7 feet, and the two steamers plying on the river time their arrival and departure so as to take advantage of the tides. From the \$6,000 appropriated by act of Congress of June 13, 1902, jointly for Petaluma Creek and Napa River, \$3,000 has been allotted to Napa River.

*Money statement.*

July 1, 1902, balance unexpended .....	\$3, 413. 41
June 30, 1903, amount expended during fiscal year .....	6. 44
July 1, 1903, balance unexpended .....	3, 406. 97
(Amount (estimated) required for completion of existing project .....	Indetermi- nate.
Amount that can be profitably expended in fiscal year ending June 30, 1905, in addition to the balance unexpended July 1, 1903 .....	3, 000. 00
Submitted in compliance with requirements of sundry civil act of June 4, 1897.	

APPROPRIATIONS.

August 12, 1888 .....	\$7, 500	June 13, 1902 .....	\$3, 000
September 19, 1890 .....	10, 000		
August 18, 1894 .....	4, 000	Total .....	28, 500
June 3, 1896 .....	4, 000		

COMMERCIAL STATISTICS.

The commerce of the river for 1901 was reported as 108,526 tons. For 1902 it is reported as 67,620 tons.

The following is a statement of the freight carried on Napa River during the year 1902:

	Tons.
Merchandise received and shipped .....	14, 250
Coal received .....	5, 500
Hay received .....	6, 900
Grain received and shipped .....	13, 300
Wine shipped .....	2, 750
Lumber received .....	19, 000
Miscellaneous received and shipped .....	5, 920
Total .....	67, 620

Steamers, 2.  
Tonnage, 990.  
Trips by steamers, daily.  
Trips by schooners, daily.

V V II.

IMPROVEMENT OF HUMBOLDT HARBOR AND BAY, CALIFORNIA.

A description of this bay, its original condition, and the plan for its improvement are given in the Annual Report of the Chief of Engineers for 1896, page 3207, and a history of the work in more detail is given in the Annual Report for 1900, page 4237.

## 2200 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

## REPORT OF OPERATIONS FOR THE FISCAL YEAR ENDING JUNE 30, 1903.

All projects heretofore contemplated for the improvement at the entrance and inside of Humboldt Bay, California, have been completed.

During the year applications were received for an extension of harbor lines beyond the localities where such lines had been established.

As no survey had been made since 1899, application was made by the Chamber of Commerce of Eureka for a resurvey of the entrance and of the channel over the bar. Authority was granted to make a resurvey of the channel over the bar, of the entrance, and of so much of the inner harbor as was necessary to reestablish harbor lines. The field work of this survey has been completed and maps are now being made.

The survey of the bar and entrance shows a channel depth of 31 feet at mean of the lower low waters, with a least width of about 250 feet, which is an increase of about 3 feet in depth over that shown in 1899, when the jetties were completed.

The trestlework on the north jetty has nearly all been destroyed by the action of the teredo and the sea; that on the south jetty remains standing from the shore out to bent No. 341, a distance of about 5,400 feet. The outer third of each jetty has been battered down to or below low-water level by violent waves, and 18 to 20 feet depth of water is now found over the outer 200-foot lengths of both jetties.

No repairs or modifications of any kind have been necessary since the completion of the work. A watchman was employed to care for the Government buildings at the locality.

*Money statement.*

July 1, 1902, balance unexpended .....	\$13, 339. 74
June 30, 1903, amount expended during fiscal year .....	1, 733. 77
July 1, 1903, balance unexpended .....	11, 605. 97

## APPROPRIATIONS.

March 2, 1881 .....	\$40, 000	March 2, 1895 .....	\$225, 000
August 2, 1882 .....	40, 000	June 11, 1896 .....	225, 000
July 5, 1884 .....	62, 500	June 4, 1897 .....	350, 000
August 5, 1886 .....	75, 000	July 1, 1898 .....	100, 000
August 11, 1888 .....	125, 000	March 3, 1899 .....	50, 000
September 19, 1890 .....	80, 000	March 3, 1899 .....	143, 115
July 13, 1892 .....	150, 000		
March 3, 1893 .....	522, 000	Total .....	2, 187, 615

## COMMERCIAL STATISTICS.

The following statement of the commerce of Humboldt Bay, California, was collected and supplied by Mr. George A. Kellogg, secretary of the Humboldt Chamber of Commerce at Eureka, Cal.:

## EXPORTS.

Articles.	Tons.	Value.
Lumber .....	334, 707	\$3, 830, 410
Produce .....	6, 198	1, 262, 900
Miscellaneous .....	12, 152	864, 115
Total .....	353, 057	5, 947, 425



## IMPORTS.

Articles.	Tons.	Value.
General merchandise.....	71,955	\$8,386,176
Miscellaneous.....	1,006	91,000
Total.....	72,961	\$8,427,176

*Movement of vessels, tonnage, and passengers.*

	Steam vessels.	Sail vessels.	Total vessels.	Tonnage.	Passengers.
Arrived.....	510	197	707	298,167	11,874
Departed.....	509	186	695	289,776	10,313
Total.....	1,019	383	1,402	587,943	22,187

## V V 12.

## IMPROVEMENT OF PEARL HARBOR, HAWAII.

A description of this harbor and the approved project for its improvement was printed in the Annual Report of the Chief of Engineers for 1901, page 2433.

During the present fiscal year the contract for dredging the bar at the entrance to the harbor was modified slightly so as to permit of an extension of time for the completion of the work and in the methods and times for making payments.

The small clam-shell dredge heretofore used was sent away and two suction dredges were substituted. One of these, belonging to the Hawaiian Territory, but chartered to a contractor, was sunk in a gale on the bar on November 18, 1902, and proved a total loss. The seas forced the wreck out of the channel and on the coral reef adjacent thereto. The other suction dredge, considering the bad weather and heavy swells encountered, did fairly good work and obtained a channel essentially 30 feet deep at low water, except in a few small areas where the depth is slightly less, which are now being cleaned out to full depth. The width of the channel is practically 200 feet. Up to June 30, 1903, 186,077 cubic yards of material had been removed in accordance with the terms of the contract. It is expected that the whole work will be completed and the contract terminated in July, 1903.

The work has been in local charge of Mr. Laurence Thompson, junior engineer, who has rendered satisfactory service.

*Money statement.*

July 1, 1902, balance unexpended .....	\$98,017.74
June 30, 1903, amount expended during fiscal year .....	69,465.12
July 1, 1903, balance unexpended .....	28,552.62
July 1, 1903, amount covered by uncompleted contracts.....	22,237.33

## APPROPRIATIONS.

March 3, 1899.....	100,000.00
--------------------	------------

2202 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

CONTRACTS IN FORCE.

- *Contract dated July 16, 1901, with Clark & Henery, for dredging channel through Pearl Harbor bar.*

Rate: 44½ cents per cubic yard.

Date of approval: July 25, 1901.

Work commenced: February 21, 1902.

Work completed: Still in progress.

---

V V 13.

MODIFICATION OF PIERHEAD LINE NORTH OF CHINA BASIN AND  
MISSION ROCK, SAN FRANCISCO HARBOR, CALIFORNIA.

BOARD OF STATE HARBOR COMMISSIONERS,  
*San Francisco, Cal., July 24, 1902.*

SIR: On my request and through your kindness and courtesy, in September, 1900, the pierhead line in the port of San Francisco was changed, except in the southerly portion of the harbor.

We now find that to accommodate the increased demands of the commerce of this port and to make necessary and contemplated improvements it is desirable to make further change in the pierhead line, as shown by the accompanying map and letter <sup>a</sup> of the chief engineer of the State board of harbor commissioners.

Thanking you for past courtesies and requesting an early consideration of this application,

I have the honor to be, very respectfully,

HENRY T. GAGE,  
*Governor of the State of California.*

Hon. ELIHU ROOT,  
*Secretary of War.*

[Second indorsement.]

OFFICE CHIEF OF ENGINEERS,  
U. S. ARMY,  
*August 6, 1902.*

Respectfully referred to Lieut. Col. D. P. Heap, Corps of Engineers, for consideration and report by the Board of Engineers on harbor lines of San Francisco Harbor and adjacent waters.

To be returned.

G. L. GILLESPIE,  
*Brig. Gen., Chief of Engineers,*  
*U. S. Army.*

[Third indorsement.]

U. S. ENGINEER OFFICE, PACIFIC DIVISION,  
*San Francisco, Cal., August 25, 1902.*

Respectfully returned to the Chief of Engineers, U. S. Army, report accompanying.

D. P. HEAP,  
*Lieutenant-Colonel, Corps of Engineers,*  
*President of Board on Harbor Lines.*

---

<sup>a</sup> Not printed.

[Fourth indorsement.]

OFFICE CHIEF OF ENGINEERS,  
U. S. ARMY,  
September 29, 1902.

Respectfully returned to the Secretary of War.

The authorities of the State of California request a modification of the established harbor line in San Francisco Harbor at points north and south of China basin and Mission rock, as shown on the accompanying blueprint.

The subject has been under consideration by the San Francisco Harbor line board, which has held a public hearing and afforded parties interested an opportunity to present their views, and attention is respectfully invited to its report, dated the 25th ultimo, herewith.

It appears that the applicants withdrew so much of their application as related to the proposed change south of China basin and Mission rock. The Board recommends that the pierhead line north of China basin and Mission rock be changed as shown in red on the accompanying blueprint. The proposed change is described as follows:

Beginning at the intersection of the pierhead line approved March 24, 1890, with a line drawn at right angles to the bulkhead line (approved on the same date) and from a point on said bulkhead line 100 feet northerly (measured along the bulkhead line) from its intersection with the northerly side of Channel street produced; thence easterly, along a continuation of the said line drawn at right angles to the bulkhead line, to a point 800 feet distant from the bulkhead line; thence northerly, at right angles to the line just described, to a point on the pierhead line approved March 24, 1890, distant 20 feet northerly (perpendicular distance) from a line parallel with the northerly line of Bryant street and 980 feet easterly from the westerly line of Spear street.

I recommend that the change proposed by the Board, shown in red on the accompanying blueprint and described as above, be approved. If approved by the Secretary of War, the change will be delineated on the original harbor-line map approved March 24, 1890, and the map will be prepared for his signature.

G. L. GILLESPIE,  
*Brig. Gen., Chief of Engineers,*  
U. S. Army.

[Fifth indorsement.]

WAR DEPARTMENT,  
October 1, 1902.

Approved as recommended by the Chief of Engineers.

E. ROOT,  
*Secretary of War.*

#### REPORT OF SAN FRANCISCO HARBOR LINE BOARD.

U. S. ENGINEER OFFICE, PACIFIC DIVISION,  
*San Francisco, Cal., August 25, 1902.*

GENERAL: I have the honor to submit the following report, in compliance with second indorsement, August 6, 1902:

A hearing was held before the United States Harbor Line Board in the office of the State harbor commissioners at 10 a. m. August 23; present, all members of the United States Harbor Line Board, the

State harbor commissioners, and a large attendance of business men engaged in commerce, shipping, and railroad interests.

This hearing had been advertised in the public prints. (See Exhibit A.<sup>a</sup>)

Circulars in regard to this hearing had been mailed to interested parties. (See Exhibit B.<sup>a</sup>)

At the hearing Mr. Paris Kilburn, president of the board of State harbor commissioners, stated that the principal object of changing the pierhead line was to afford dock facilities north of China basin and of Mission rock for the steamers of the Pacific Mail Company. (See accompanying blueprint.<sup>a</sup>)

The only objection raised was by Mr. A. H. Payson, assistant to the president of the Atchison, Topeka and Santa Fe Railway system, and this objection was confined to the proposed change in pierhead line south of China basin and Mission rock. (See Exhibit C.<sup>a</sup>)

It is proper to state that the Santa Fe Railway system has leased China basin for a term of years from the State of California and is making extensive improvements.

Mr. Kilburn stated to the meeting that the proposed changes of pierhead lines south of China basin were of no special importance, could well be omitted from the application, and that he desired to amend the application so as to make this omission.

No other objections being made, the meeting was adjourned.

The United States Harbor Line Board recommends that the pierhead line north of China basin and Mission rock be changed, as shown in red on accompanying blueprint,<sup>a</sup> but that no change be made south of China basin.

\* \* \* \* \*

Respectfully submitted.

D. P. HEAP,  
*Lieut. Col., Corps of Engineers,*  
*President U. S. Harbor Line Board,*

W. H. HEUER,  
*Lieut. Col., Corps of Engineers,*

THOS. H. HANDBURY,  
*Lieut. Col., Corps of Engineers,*  
*Members U. S. Harbor Line Board.*

Brig. Gen. G. L. GILLESPIE,  
*Chief of Engineers, U. S. A.*

---

<sup>a</sup> Not printed.

## APPENDIX W W.

### IMPROVEMENT OF RIVERS AND HARBORS IN WESTERN OREGON, OF COLUMBIA RIVER ABOVE THE MOUTH OF WILLAMETTE RIVER, INCLUDING SNAKE RIVER, OREGON AND WASHINGTON.

REPORT OF MAJ. W. C. LANGFITT, CORPS OF ENGINEERS, OFFICER  
IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1903, WITH  
OTHER DOCUMENTS RELATING TO THE WORKS.

#### IMPROVEMENTS.

- |   |  |
|---|--|
| 1. Coquille River, Oregon, between Coquille and Myrtle Point. | 8. Columbia River at Three-mile Rapids, Oregon and Washington.                           |
| 2. Entrance to Coos Bay and Harbor, Oregon.                   | 9. Canal at the Cascades, Columbia River, Oregon.  |
| 3. Coos River, Oregon.  | 10. Operating and care of canal and locks at the Cascades of the Columbia River, Oregon. |
| 4. Mouth of Siuslaw River, Oregon.                            | 11. Columbia River between Vancouver, Washington, and mouth of Willamette River.         |
| 5. Yaquina Bay, Oregon.                                       |  |
| 6. Tillamook Bay and bar, Oregon.                             |  |
| 7. Upper Columbia and Snake rivers, Oregon and Washington.    |  |

#### SURVEYS.

- |                                    |   |
|------------------------------------|---|
| 12. Siuslaw River, Oregon.         | 14. Snake River, Idaho, from mouth of Imnaha River to Lewiston. |
| 13. Tillamook Bay and bar, Oregon. |   |

ENGINEER OFFICE, UNITED STATES ARMY,  
*Portland, Oreg., July 15, 1903.*

GENERAL: I have the honor to transmit herewith annual report  
\* \* \* for the fiscal year ending June 30, 1903, for works of river  
and harbor improvement in my temporary charge.

Very respectfully, your obedient servant,

W. C. LANGFITT,  
*Major, Corps of Engineers.*

Brig. Gen. G. L. GILLESPIE,  
*Chief of Engineers, U. S. A.*

#### W W 1.

### IMPROVEMENT OF COQUILLE RIVER, OREGON, FROM COQUILLE CITY TO MOUTH.

Information concerning the project for the construction of jetties at  
the mouth of the Coquille River is given in the summary of this report.  
During the fiscal year ending June 30, 1903, the north jetty tramway

has been extended seaward about 360 feet, a foundation mattress laid throughout this distance, and about 5,632 tons of rubblestone enrockment placed thereon. The work was done under contract with John Kiernan, of Portland, Oreg., dated November 10, 1902, and approved November 28, 1902. Operations under the contract were commenced on November 17, 1902. The work to be done under the contract consists of extending the north jetty seaward a distance of about 555 feet, by building a tramway that distance on the line of the projected work, laying a foundation mattress of brush fascines, and enrocking the north jetty by dumping on the mattress foundation rubble sandstone in pieces weighing from 100 pounds to 10 tons.

The average size of the pieces to weigh at least two tons; one-fourth of the pieces furnished to weigh at least four tons; one-half of the pieces furnished to weigh at least two tons and up to four tons each; and one-fourth of the pieces furnished to weigh between 100 pounds and 500 pounds each.

The contractor was allowed the free use on the work of the Government plant used in jetty construction in former years. This plant is old and nearly worn-out by use and age.

The contractor quarries the stone about 11 or 12 miles up the Coquille River from its mouth and tows it to the Parker wharf, about 3,600 feet from the commencement of the north jetty, where it is loaded on cars and run out on the jetty tramway and dumped to place.

A supplementary agreement was entered into with John Kiernan, December 2, 1902, under the terms of which the United States agreed to pay him the sum of \$1,300 in consideration of his rebuilding the Parker wharf and extending the single track from it to the north jetty, all his right to wharf and approach to be relinquished upon completion of the contract. This was done on account of the shoaling in front of the old wharf and the difficulty of mooring scows.

The stone used is a sandstone of rather poor quality, weighing about 145 pounds per cubic foot. The contractor commenced the extension of the north jetty tramway March 19, 1903.

The method of construction of the brush mattresses and jetty tramway is the same as that described in Annual Report of the Chief of Engineers for 1901, page 3465.

Up to June 30, 1903, the contractor placed the following-named quantities of materials in the north jetty:

Piles, 4,025 linear feet, at 16 cents per linear foot .....	\$644.00
Lumber, 43,491 feet B. M., at \$14 per 1,000 feet B. M. ....	608.87
Ship spikes, 175 pounds, at 10 cents per pound .....	17.50
Driftbolts, 2,282 pounds, at 10 cents per pound .....	228.20
Old rails relaid, 11.85 tons of 2,000 pounds, at \$11 per ton ..	130.35
New railroad spikes, 1,050 pounds, at 8 cents per pound .....	84.00
Mattresses, 421.2 cubic yards, at \$1.50 per cubic yard .....	631.80
New fish plates, 125 pairs, at \$1.10 per pair .....	137.50
New bolts and nuts for fish plates, 200 pounds, at 15 cents per pound ..	30.00
Stone per ton of 2,000 pounds, 5,632.30 tons, at 85 cents per ton .....	4,787.46
Total .....	7,299.63

The placing of the above-named materials resulted in the extension, in the partially completed state, of the north jetty 360 feet seaward.

It is estimated that under the contract now in force the north jetty will be extended 555 feet, making its total constructed length about 1,065 feet, and leaving 515 feet yet to build to complete its full length according to the approved project.

A rock in the channel, whose outer point is about 180 feet from the south jetty and immediately inside the mouth of the river, the top of which is about 2 feet below the surface at mean low tide, is a menace to navigation and has already caused slight injury to several vessels.

This rock is about 120 feet long by 50 feet wide, and it is hard and tough.

An attempt was made to remove it in 1900 (see Report of Chief of Engineers for 1900, p. 4269), but the rock proved to be of greater dimensions than was thought and it was given up. Authority is given by first indorsement, Office Chief of Engineers, December 20, 1902, to include mention of it in this report.

To afford necessary relief to navigation, the rock should either be blasted and removed to a depth of at least 8 feet below the plane of mean lower low water, or possibly a spur jetty built between it and the south jetty, and thus divert the ship channel away from it to the north.

It is estimated that either plan will cost about \$6,000, which sum should be added to the amount estimated to complete the project.

This work is probably worthy of being undertaken by the General Government.

It is estimated that it will cost \$45,000 to complete the north jetty in accordance with the project. The work can be done in about six months, and this sum is named in the money statement as amount required.

Mr. William G. Carroll, junior engineer, has been in local charge of the work in progress at the mouth of the river during the past fiscal year.

#### *Money statement.*

July 1, 1902, balance unexpended .....	\$31,948.18
June 30, 1903, amount expended during fiscal year .....	9,146.51
July 1, 1903, balance unexpended .....	22,801.67
July 1, 1903, outstanding liabilities .....	3,068.10
July 1, 1903, balance available .....	19,713.57
July 1, 1903, amount covered by uncompleted contracts .....	19,000.00
{ Amount (estimated) required for completion of existing project .....	45,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1905, in addition to the balance unexpended July 1, 1903 .....	45,000.00
{ Submitted in compliance with requirements of sundry civil act of June 4, 1897.	

#### APPROPRIATIONS.

Act of—		Act of—	
June 14, 1880 .....	\$10,000	August 18, 1894 .....	\$20,000
August 2, 1882 .....	10,000	June 3, 1896 .....	20,000
July 5, 1884 .....	10,000	March 3, 1899 .....	40,000
August 5, 1886 .....	20,000	June 13, 1902 .....	30,000
August 11, 1888 .....	25,000		
September 19, 1890 .....	30,000	Total .....	240,000
July 13, 1892 .....	25,000		

## 2208 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

CONTRACT IN FORCE FOR EXTENDING NORTH JETTY (MATTRESS, ROCK, AND PILE WORK).

Name of contractor: John Kiernan.  
 Date of contract: November 10, 1902.  
 Date of approval: November 28, 1902.  
 Date of beginning: November 17, 1902.  
 Date of expiration: November 2, 1903.

## COMMERCIAL STATISTICS.

The following commerce was carried by vessels across the bar at the mouth of the river during the calendar year 1902:

Articles.	Inbound.	Outbound.
	Tons.	Tons.
Broom handles.....		999
Coal.....		3,410
Dairy produce.....		91
Fish.....		117
Grain.....		85
Hay.....	80	
Hides.....		2
Lumber.....		25,246
Match wood.....		3,221
Miscellaneous.....	3,691	425
Poles.....		20
Wool and woolen goods.....		71
Total.....	3,771	38,667

Number of passengers arrived by sea, 195; departed by sea, 201.

List of vessels crossing bar at mouth of Coquille River, Oregon, during year ending December 31, 1902.

Name.	Character.	Length.	Breadth.	Depth of hold.	Draft when fully laden.	Net tonnage.	Number of times arrived.	Number of times departed.	Total number of times arrived and departed.
		Feet.	Feet.	Feet.	Feet.				
Advance.....	Sail.....	139.8	34.4	9.4	11.5	265	1	2	3
Albion.....	do.....	80.5	27	5	8	75	6	7	13
Argo.....	Steam.....	117.5	21.8	9.6	10	112	5	5	10
Aurelia.....	do.....	160.9	34.6	11.6	13	309	1	1	2
Berwick.....	Sail.....	82.6	27.4	7.1	9	95	5	5	10
Bessie K.....	Gasoline.....	84.5	26.2	7.6	9	93	1	2	3
Confianza.....	Sail.....	78	25.5	7	9	84	2	2	4
Corinthian.....	do.....	81	25.6	6.8	9	80	7	3	15
Coquille.....	do.....	92.9	29.5	6.4	8.5	97	8	8	16
Del Norte.....	do.....	82.6	27.4	7.1	9	95	1	1	2
Gem.....	do.....	106.9	30	7	9	114	4	3	7
Lizzie Prien.....	do.....	94.8	30.6	6.4	8	91	2	2	4
Mandalay.....	Steam.....	148	33.6	12	13	266	20	20	40
Mayflower.....	Sail.....	80.5	26.5	6.2	8	86	8	9	17
Monteray.....	Gasoline.....	98.5	28	7.5	10	119	2	2	4
Ocean Spray.....	Sail.....	80	25.5	7	8	71	5	4	9
Onward.....	do.....	134.1	35.4	10	12	255	8	9	17
Parkersburgh.....	do.....	100	31	6.5	8.5	117	6	6	12
Ruby.....	do.....	132	34	9	10.5	306	2	2	4
Total.....							98	98	191



W W 2.

IMPROVEMENT OF ENTRANCE TO COOS BAY AND HARBOR, OREGON.

For information concerning the approved project for the improvement of Coos Bay and Harbor, Oregon, attention is invited to the summary of this report.

No active operations were carried on during the fiscal year ending June 30, 1903, and the expenditures made during that time were limited to caring for the Government plant used in the work of jetty construction in former years and in planting about 62 acres on the north spit with Holland grass roots (*Arundo arenaria*), the roots being taken from former plantations. This grass has lived and spread and proved itself adapted for use in the reclamation of the sandy spit.

The last active work on the jetty was done under contract with Wakefield & Jacobsen, of Portland, Oreg., dated August 15, 1899, work under which contract was completed March 15, 1901. Since the cessation of work the sea end of the jetty enrockment has been beaten down by the heavy seas until the crest of the outer 650 feet of the enrockment, which was left at a height of about 20 feet above low tide, is now from 1 to 20 feet below that level. At the present time the enrockment is below low water, beyond bent No. 603.

The wharf and jetty tramway is getting old and the piles are eaten by the teredo, and, together with the caps and stringers, are badly decayed. The Government plant at Coos Bay used in past years has become deteriorated through use and age.

A recommendation that the funds available be withheld, owing to the relatively small amount and to the fact that the depths contemplated by the project has been obtained and fairly well maintained, was approved.

A recent examination of Coos Bay bar showed but 17 feet depth on its crest at mean lower low water. Should the shoaling which is thus shown not prove temporary or increase, further work will soon be necessary. It is hoped this will not be the case, as this is the best harbor between the mouth of the Columbia and San Francisco and is worthy of being maintained in its present condition.

The construction of a small survey steamer for coast harbors, to replace the present one condemned as unseaworthy, has been authorized, the expense of its construction to be met in part from funds available for this work.

*Money statement.*

July 1, 1902, balance unexpended.....	\$57,983.68
June 30, 1903, amount expended during fiscal year.....	1,403.75
July 1, 1903, balance unexpended.....	56,579.93
(Amount (estimated) required for completion of existing project...)	1,741,412.20
Amount that can be profitably expended in fiscal year ending June 30, 1905, in addition to the balance unexpended July 1, 1903.....	75,000.00
Submitted in compliance with requirements of sundry civil act of June 4, 1897.	

# 2210 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

## APPROPRIATIONS.

Act of—		Act of—	
March 3, 1879.....	\$40,000.00	June 3, 1896.....	\$95,000.00
March 3, 1881.....	80,000.00	March 3, 1899.....	150,000.00
August 2, 1883.....	80,000.00	November 10, 1900, re-	
July 5, 1884.....	80,000.00	fundment of overpay-	
August 5, 1886.....	83,750.00	ment <sup>a</sup> .....	56
August 11, 1888.....	50,000.00	June 13, 1903.....	50,000.00
September 19, 1890.....	125,000.00		
July 13, 1892.....	210,000.00	Total.....	938,750.56
August 18, 1894.....	95,000.00		

## COMMERCIAL STATISTICS.

The following commerce was carried by vessels across the bar at the entrance to the bay during the calendar year 1902:

Articles.	Inbound.	Out-bound.
	Tons.	Tons.
Broom handles.....		255
Coal.....		44,438
Chittim bark.....		109
Dairy produce.....		521
Eggs.....		60
Fruit.....		270
Fish.....		61
Lumber.....		56,450
Laths.....		2,419
Live stock.....		15
Machinery.....	96	
Match wood.....		1,397
Miscellaneous.....	10,411	3,575
Flies.....		634
Spars.....		31
Vegetables.....		746
Wool.....		10
Total.....	10,507	111,725

Number of passengers arrived by sea, 1,559; departed by sea, 1,637.

List of vessels crossing the bar at entrance to Coos Bay, Oregon, during the year ending December 31, 1902.

Name.	Character.	Length.	Breadth.	Depth of hold.	Draft when fully laden.	Net tonnage.	Number of times arrived.	Number of times departed.	Total number of times arrived and departed.
		Feet.	Feet.	Feet.	Feet.				
Acme.....	Steam.....	177.5	37	15	14	275	3	2	4
Advent.....	Sail.....	151.5	35	12.6	17	300	1	1	2
Alliance.....	Steam.....	164.4	35.6	12	16	431	43	43	84
Alumna.....	Sail.....	189.1	40	15.6	18	644	1	1	2
Arcata.....	Steam.....	180	26.2	9	13	415	37	37	74
Argus.....	Sail.....	166	40	13	16	526	1	1	2
Astoria.....	Steam.....	109.5	23	12.5	16	76	3	3	6
Baroda.....	Sail.....						1	1	2
Brunswick.....	Steam.....	141.3	34.4	12.2	15	274	1	1	2
Chas. Counselman.....	do.....	85.5	21.2	10.3	8	55	1	1	2
Chas. E. Falk.....	Sail.....	142.3	34	9	10	245	3	7	15

<sup>a</sup> Overpayment of 56 cents made on voucher No. 5, for June, 1900, refunded November 10, 1900.

*List of vessels crossing the bar at entrance to Coos Bay, Oregon, during the year ending December 31, 1902—Continued.*

Name.	Character.	Length.	Breadth.	Depth of hold.	Draft when fully laden.	Net tonnage.	Number of times arrived.	Number of times departed.	Total number of times arrived and departed.
		<i>Feet.</i>	<i>Feet.</i>	<i>Feet.</i>	<i>Feet.</i>				
Omarina.....	Steam.....	216	30.8	14.1	17	798	3	1	3
Defiance.....	do.....	123	22.2	14.2	15	127	1	1	2
Elia Thompson.....	do.....	195.1	28	20.6	17	448	1	1	2
Elisa Miller.....	Sail.....	108	29	9	10	148	3	3	6
Empire.....	Steam.....	170.1	32.7	20.1	17	535	24	24	48
Emma Utter.....	Sail.....	134.7	33.1	10.1	13	265	6	5	11
Free Trade.....	do.....	88.5	23.4	6.2	9	87	3	3	6
Falcon.....	do.....	125.6	29	9	10	195	5	5	10
Gem.....	do.....	107	30	7	11	114	5	5	10
Glen.....	do.....	106.6	29	8.2	10	121	2	2	4
Gotama.....	do.....	119	32.6	8.6	11	188	2	2	4
Guide.....	do.....	126	23.7	7.4	10	137	3	3	6
Homar.....	Steam.....	146	33.8	17	14	331	1	1	2
Hunter.....	do.....	95	21.7	10.4	11	52	21	21	42
Ivy.....	Sail.....	102.5	23.8	8.8	10	135	10	10	20
Joseph Russ.....	do.....	124	30	9.6	12	235	4	4	8
Jennie Wand.....	do.....	124	32.3	9	12	163	8	8	16
Jennie Thelin.....	do.....	91	29.5	8.2	10	138	1	1	2
Jessie Minor.....	do.....	129	32.5	9.2	11	219	7	7	14
John F. Miller.....	do.....	107	30.6	9	12	170	2	2	4
Katie Cook.....	Steam.....	57.5	15.2	5.8	6	19	1	1	2
Lettitia.....	Sail.....	112	23.5	10.4	12	233	1	1	2
Maggie C. Russ.....	do.....	117	30	9	12	186	3	3	6
Manzanita.....	Steam.....	152	26	11.5	12	450	3	3	6
Mary E. Russ.....	Sail.....	115.5	33	9.6	12	223	1	2	3
Maroon.....	do.....	176.3	39	15	17	638	1	1	2
Melanchthon.....	do.....	133	30.5	10.9	16	233	4	5	9
North Bend.....	do.....	153.5	32.8	11.2	16	367	1	1	2
Northwest.....	do.....	147.9	36.8	12.9	16	439	1	1	2
Novelty.....	do.....	168.2	39	12	16	584	1	1	2
Orient.....	do.....	128.6	30	10.9	12	296	2	2	4
Polaris.....	do.....	195.1	40	15.6	18	717	1	1	2
Repeat.....	do.....	143.9	34.4	12	14	410	3	2	5
Rescue.....	Steam.....	104	26	12.1	14	86	1	1	2
Roberts.....	do.....	75.5	18.2	6.5	8.6	24	6	6	12
Rogue River.....	do.....	65.5	16.4	8.6	2	50	1	1	2
San Buenaventura.....	Sail.....	107	30	8.5	10	171	1	1	2
Santa Paula.....	do.....	133	30.3	16.1	17	633	1	1	2
Signal.....	Steam.....	150	34.4	12.8	16	332	16	15	31
South Coast.....	do.....	131.5	32.2	10.5	14.6	225	1	1	2
South Portland.....	do.....	180.2	29	19.7	17.6	579	1	1	2
Taurus.....	Sail.....	161	40	12	16	514	1	1	2
Una.....	do.....	118.2	31.5	9.8	12	197	1	2	3
Volunteer.....	do.....	122.4	33.9	12	15	542	1	1	2
Webfoot.....	do.....	145.5	31.6	10.8	12	343	4	4	8
Western Home.....	do.....	95.5	29	7.9	10	128	9	9	18
Copper Queen.....	Gasoline.....	50	11.8	4.6	5	5	5	5	10
Monterey.....	do.....	93	28	8	10	119	2	2	4
Total.....							279	281	560

## W W 3.

## IMPROVEMENT OF COOS RIVER, OREGON.

The project for obtaining a channel 50 feet wide, free from obstructing boulders and snags, from the mouth of the river in Coos Bay to the head of tide on the North and South forks, and the result of operations, are mentioned in the Annual Report of the Chief of Engineers for 1900, pages 644, 645, and 4283, 4284.

No work was carried on during the past fiscal year and no expendi-

## 2212 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

tures were made in connection with the improvement as the condition of the river was so good that it was deemed better to defer any work until after the next freshet, for which the entire appropriation (\$2,000) of act of June 13, 1902, is still available.

The sum previously appropriated (\$2,000) has been held, as urgent work has not been called for. This river, however, will no doubt soon need attention, and \$2,000 additional at least will be needed.

### *Money statement.*

July 1, 1902, balance unexpended .....	\$2,000.00
July 1, 1903, balance unexpended .....	2,000.00
<hr/>	
{ Amount that can be profitably expended in fiscal year ending June 30, 1905, for maintenance of improvement, in addition to the balance unexpended July 1, 1903 .....	2,000.00
{ Submitted in compliance with requirements of sundry civil act of June 4, 1897, and of section 7 of the river and harbor act of 1899.	

### APPROPRIATIONS.

Act of—	
June 3, 1896 .....	\$5,000
March 3, 1899 .....	3,000
June 13, 1902 .....	2,000
Total .....	10,000

### COMMERCIAL STATISTICS.

At the close of the fiscal year the traffic on Coos River is not available. It is estimated, however, that a total of approximately 46,000 tons was carried over the river during the calendar year ending December 31, 1902. This consisted principally of agricultural and lumber products shipped to market and miscellaneous merchandise, loggers' supplies, tools, etc., distributed to the merchants and residents along the river. The amount reported the previous year was 62,402 tons. This decrease is accounted for owing to the fact that no stone was transported for the jetty at the entrance to Coos Bay.

The traffic on Coos River during the year ending December 31, 1902, was handled principally by the following-named craft:

Name.	Character.	Length.	Breadth.	Depth.	Draft loaded.	Net tonnage.
		<i>Feet.</i>	<i>Feet.</i>	<i>Feet.</i>	<i>Feet.</i>	
Alert .....	Stern-wheel .....	81	18	4	3	31
Alma .....	Screw-propeller .....	50	12	3	2	9
Blanco .....	do .....	61	16	5	5	13
Coos River .....	do .....	44	12	5	4	8
Cruiser .....	do .....	70	16	6	6	33
Flyer .....	do .....	63	15	5	6	31

In addition to the above-named there are several gasoline boats and launches in the stream owned and operated by farmers living in the valley. Owing to the formation of the country transportation other than by water is at present impracticable. The stream is therefore used as a highway for transporting practically all the commerce and passengers of the region.

## W W 4.

## IMPROVEMENT OF MOUTH OF SIUSLAW RIVER, OREGON.

The only operations during the past fiscal year were in connection with the watching and caring for the Government plant used in construction of the north jetty in past years, and in making a reexamination and survey of the bar and river, as called for by act of June 13, 1902, and as set forth in the summary of this report.

A survey was made in August and September, 1902, and the map of it shows a least depth in the bar channel of 5 feet at mean lower low tide, and a least depth over the shoal above Florence opposite the mouth of the north fork of 7 feet at the same stage of tide.

A report of the above survey was submitted under date of February 5, 1903. This report was referred to the Board of Engineers for Rivers and Harbors for consideration and report as to the advisability of continuing the improvement. (See Appendix W W 12.) The Board's report is dated March 26, 1903, and the following is an extract of the report of the above-mentioned Board.

The statistics from 1892 to 1901 show an annual commerce, incoming and outgoing, which varies between 2,381 and 22,351 tons, with no uniform increase. The town of Florence, which appears to be the most important point on the river, is reported in the census of 1900 as having a population of 222.

The improvement, if carried out, may cost \$481,320 in addition to the sums already expended. It is designed to produce a bar depth of 8 feet, or 2 feet increase over the present depth. One of the chief present complaints is that vessels trying to enter or leave the harbor may be bar bound for long periods. It is not apparent that the small projected increase in depth would make the bar channel navigable at all times, or would even greatly reduce the periods during which it would be impassable.

The present commerce of the Siuslaw River is insignificant. The prospective commerce, if carried on a bar depth of only 8 feet, would not probably be great enough to warrant the execution of the costly work proposed. At the mouth of the Umpqua River, only about 20 miles to the south of the Siuslaw, there is a natural bar depth of nearly 18 feet at low water, with practically similar if not superior promise of commerce; yet this depth has not sufficed to create or maintain a trade which would warrant an expenditure such as would be required to produce only 8 feet at the Siuslaw bar. A considerable increase of depth over 8 feet, without which no extensive trade would probably be developed, would increase the cost of the project, and is therefore put out of present consideration by the law ordering the reexamination, which contemplates a reduction in cost.

The act constituting the Board requires that it shall submit to the Chief of Engineers recommendation as to the desirability of commencing or continuing any and all improvements upon which reports are required. Complying with this provision of the law the Board reports that in its opinion it is not desirable to continue the improvement of the Siuslaw River, with the view of obtaining a depth of 8 feet.

The condition of the partially built north jetty remains about as it was at the close of last active operations in December, 1900.

Should Congress decide to go on with this work the balance available is too small for economical prosecution and an additional appropriation, in this contingency, of at least \$70,000 should be made, and this sum is therefore named in the money statement for expenditure to June 30, 1905.

\* \* \* \* \*

## 2214 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

*Money statement.*

July 1, 1902, balance unexpended .....	\$35,299.17
June 30, 1903, amount expended during fiscal year .....	8,511.27
July 1, 1903, balance unexpended .....	81,787.90
{ Amount (estimated) required for completion of existing project.....	518,000.00
{ Amount that can be profitably expended in fiscal year ending June	
80, 1905, in addition to the balance unexpended July 1, 1903.....	70,000.00
{ Submitted in compliance with requirements of sundry civil act of June	
4, 1897.	

## APPROPRIATIONS.

Act of—		Act of—	
September 19, 1890.....	\$50,000	March 3, 1899.....	\$30,000
July 13, 1892.....	20,000	June 13, 1903.....	85,000
August 18, 1894.....	25,000		
June 3, 1896.....	27,000	Total.....	187,000

## COMMERCIAL STATISTICS.

\* \* \* \* \*

The following commerce was carried by vessels across the bar at the mouth of the river during the year ending December 31, 1902:

Articles.	Inbound.	Out-bound.
	Tons.	Tons.
Chittim bark.....		105
Dairy produce.....		10
Fish.....		234
Fruit.....		44
Laths.....		200
Lumber.....		23,497
Miscellaneous.....	1,943	100
Wool and woolen goods.....		29
Total.....	1,943	23,270

Number of passengers arrived by sea, 60; departed by sea, 60.

List of vessels crossing the bar at entrance to Siuslaw River, Oregon, during the year ending December 31, 1902.

Name.	Character.	Length.	Breadth.	Depth of hold.	Draft when fully laden.	Net tonnage.	Number of times arrived.	Number of times departed.	Total number of times arrived and departed.
		Feet.	Feet.	Feet.	Feet.				
Acme.....	Steam.....	162	34	10.6	14.6	227	10	10	20
C. A. Klose.....	Sail.....	145	33.5	9	11	370	2	2	4
Bella.....	do.....	121	32	9	11	147	5	4	9
Bender Brothers.....	do.....	77.5	24.8	6.8	9	80	6	6	11
Bessie K.....	Gasoline.....	84.5	23.2	7.6	9	28	1	1	2
Free Trade.....	Sail.....	88.5	23.4	6.2	9	87	1	1	2
Gen. H. G. Wright.....	Steam.....	65	15	3	7.6	44	1	1	2
Gem.....	Sail.....	107	30	7	9	114	1	1	2
Lizzie Prieon.....	do.....	94.8	30.6	6.4	9	91	1	1	2
Mary Etta.....	do.....	71	23	6.3	9	61	4	4	8
Monteray.....	Gasoline.....	96.5	23	7.5	10	119	1	1	2
Nettle Sundborg.....	Sail.....	74	25.4	6	8	63	1	1	2
Oakland.....	do.....	143	35.6	9.5	14	333	2	2	4
Roberts.....	Steam.....	75.5	18.2	6.5	8.6	24	13	13	26
Sacramento.....	Sail.....	100.7	31.2	6.5	9	124	7	7	14
S. Danielson.....	do.....	92	27.6	6.8	8	83	2	2	4
Wing and Wing.....	do.....	104	30	8.2	11	124	4	4	8
Total.....							65	64	129

## W W 5.

## IMPROVEMENT OF YAQUINA BAY, OREGON.

The various projects for the improvement of Yaquina Bay, Oregon, are mentioned in the summary of this report.

There were no operations during the past fiscal year other than those in connection with the watching and caring for Government plant used in the construction of the jetties in past years.

The north and south jetties are fairly well maintained, although somewhat beaten down by the sea near their outer ends. The jetty tramway, used to deposit the stone on the jetties in former years, has nearly all decayed and been carried away by the sea.

*Money statement.*

July 1, 1902, balance unexpended .....	\$4,926.62
June 30, 1903, amount expended during fiscal year .....	854.64
July 1, 1903, balance unexpended .....	4,071.98
July 1, 1903, outstanding liabilities .....	4.50
July 1, 1903, balance available .....	4,067.48

## APPROPRIATIONS.

Act of—		Act of—	
June 14, 1880 .....	\$40,000	September 19, 1890 .....	\$165,000
March 3, 1881 .....	10,000	July 13, 1892 .....	85,000
August 2, 1882 .....	60,000	August 18, 1894 .....	50,000
July 5, 1884 .....	50,000	June 3, 1896 .....	25,000
August 5, 1886 .....	75,000		
August 11, 1888 .....	150,000	Total .....	710,000

## COMMERCIAL STATISTICS.

The following commerce was carried by vessels across the bar at the entrance to the bay during the year ending December 31, 1902.

Articles.	Inbound.	Out-bound.
	Tons.	Tons.
Fish .....	123	518
Flour and feed .....		45
Grain .....		250
Lumber .....	112	100
Miscellaneous .....	4	
Wool and woolen goods .....		
Total .....	239	913

Number of passengers arrived by sea, 31; departed by sea, 16.

## 2216 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

*List of vessels crossing the bar at entrance to Yaquina Bay, Oregon, during the year ending December 31, 1902.*

Name.	Character.	Length.	Breadth.	Depth of hold.	Draft when fully laden.	Net tonnage.	Number of times arrived.	Number of times departed.	Total number of times arrived and departed.
		<i>Feet.</i>	<i>Feet.</i>	<i>Feet.</i>	<i>Feet.</i>				
Acme .....	Steam .....	182	34	10.6	14.6	227	3	3	6
Anita .....	Gasoline .....	82	24.3	6.2	7	83	3	3	6
Copper Queen .....	do .....	55	11.8	4.6	5	6.23	1	1	2
George H. Vosburg .....	Steam .....	75.5	20	8.7	10	96	2	2	4
Hunter .....	do .....	95	22	10	11	53	3	3	6
Manzanita .....	do .....	152	26	11.5	13	---	2	2	4
Robarts .....	do .....	75.5	18.2	6.5	8.6	24	13	13	26
W. H. Harrison .....	do .....	92	20.1	6.8	8	52	3	3	6
Total .....	-----	-----	-----	-----	-----	-----	80	29	59

## W W 6.

## IMPROVEMENT OF TILLAMOOK BAY AND BAR, OREGON.

Attention is invited to the summary of this report for information concerning the project (now completed) for obtaining a least depth of 9 feet at mean high tide in a selected channel between Hobsonville, on Tillamook Bay, and Tillamook City, on Hoquarten Slough, as well as the results of operations in former years.

The river and harbor act of June 13, 1902, made provision for the improvement of Tillamook Bay as follows:

Completing improvement, twenty-seven thousand dollars; and the Secretary of War is authorized and directed to cause to be made a survey and an estimate of the cost of securing channels across said bar of fifteen and twenty feet in depth, respectively.

In October, 1902, a careful hydrographic survey was made of the ocean bar at Tillamook Bay and was extended as far up the main channel of the bay and Hoquarten Slough as the mouth of Stillwell ditch. The survey was made by Mr. Morton L. Tower, junior engineer, who has since been in local charge of the improvement.

Upon the completion of the survey and map, plans and estimates of costs for securing least bar depths at mean lower water of 15 and 20 feet, respectively, were prepared and forwarded to the Chief of Engineers with report dated April 13, 1903, which is printed herewith in Appendix W W 13.

The survey up the bay channel showed a slight improvement in channel depth at the various shoal places, there being nowhere less than the projected depth of 9 feet at mean high tide, although many snags were discovered in Hoquarten Slough and several narrow and crooked places in the upper bay and slough channel that require widening and straightening by dredging.

The small Government dredge was put in commission and the work of snagging and dredging by hired labor commenced February 23, 1903.

Up to the present time 1,245 snags have been removed and Hoquarten Slough dredged to a point below Dry Stocking bar, and a small scow has been built and added to the plant.

The dikes at Junction Island and near Bakers Landing need some straightening by the addition to them of riprap stone to compensate for settlement. It is proposed to spend the balance of the available



funds in this work and in further dredging of the upper bay channel, as well as in some additions and improvements to the Government plant.

It is expected that this work will be completed by the end of the calendar year.

It is estimated that \$10,000 will be needed every two years to maintain this work, and in addition certain changes in and additions to the plant are essential, as found by experience, for profitable work. These changes, etc., are estimated to cost approximately \$6,000. The sum of \$16,000 is therefore the amount named in the money statement for expenditure to June 30, 1905.

Index map of the locality under improvement is transmitted herewith.

Mr. Morton L. Tower, junior engineer, was in local charge of this work during the past fiscal year.

#### Money statement.

July 1, 1902, balance unexpended .....	\$27,081.89
June 30, 1903, amount expended during fiscal year .....	8,618.24
July 1, 1903, balance unexpended .....	18,463.15
July 1, 1903, outstanding liabilities .....	809.00
July 1, 1903, balance available .....	17,654.15
{ Amount that can be profitably expended in fiscal year ending June 30, 1905, for maintenance of improvement, in addition to the balance unexpended July 1, 1903 Submitted in compliance with requirements of sundry civil act of June 4, 1897, and of section 7 of the river and harbor act of 1899.	
	16,000.00

#### APPROPRIATIONS.

Act of—		Act of—	
August 11, 1888 .....	\$5,200.00	Refundment of overpay-	
September 19, 1890 .....	500.00	ments, November 10,	
July 13, 1892 .....	15,000.00	1900 .....	\$4.68
August 18, 1894 .....	16,000.00	June 13, 1902 .....	27,000.00
June 3, 1896 .....	17,000.00	Total .....	105,704.68
March 3, 1899 .....	25,000.00		

#### COMMERCIAL STATISTICS.

The following statistics are for the calendar year 1902:

Articles.	Inbound.	Out-bound.
	Tons.	Tons.
Coal .....	142	963
Dairy produce .....		41
Eggs .....		294
Fish .....		
Fruit .....	131	
Grain, feed, and flour .....	1,760	
Hay .....	20	
Laths .....		31
Lumber .....		19,327
Machinery .....	705	
Miscellaneous merchandise .....	1,069	119
Vegetables .....		53
Wool and woolen goods .....	230	
Total .....	4,057	20,826

Number of passengers arriving and departing by sea during the year, 1,702.

# 2218 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

*List of vessels crossing the bar at entrance to Tillamook Bay, Oregon, during year ending December 31, 1902, which proceeded as far as or departed from Tillamook City, Oreg.*

Name.	Character.	Length.	Breadth.	Depth of hold.	Draft when fully laden.	Net tonnage.	Number of times arrived.	Number of times departed.	Total number of times arrived and departed.
		<i>Feet.</i>	<i>Feet.</i>	<i>Feet.</i>	<i>Feet.</i>				
Sue H. Elmore.....	Steam.....	90.7	23.8	8	10	131	45	44	89
Geo. E. Vosburg.....	do.....	75.5	20	8.7	9	96	50	49	99
W. H. Harrison.....	do.....	98	20.1	6.8	8.5	52	2	2	4
Total.....							97	95	192

*List of vessels crossing the bar at entrance to Tillamook Bay, Oregon, during year ending December 31, 1902, which did not go above nor depart from above Bay City, Oreg.*

Name.	Character.	Length.	Breadth.	Depth of hold.	Draft when fully laden.	Net tonnage.	Number of times arrived.	Number of times departed.	Total number of times arrived and departed.
		<i>Feet.</i>	<i>Feet.</i>	<i>Feet.</i>	<i>Feet.</i>				
Acme.....	Steam.....	162	34	10.6	14.6	227	1	1	2
Chico.....	do.....	146.6	28.8	18	15	836	1	1	2
Homer.....	do.....	146	33.8	17	14.9	831	2	2	4
Kruger.....	do.....	160	30	12	15	851	14	14	28
Luella.....	do.....	137.2	32.5	10.6		243	1	1	2
Meteor.....	do.....	258.6	43.2	24.2	20	1,565	1	1	2
Redondo.....	do.....	188	38	11.5	15	462	4	4	8
South Coast.....	do.....	131.5	32.2	10.5	14.6	325	1	1	2
South Portland.....	do.....	180.2	29	19.7	17.6	579	2	2	4
Total.....							27	27	54

W W 7.

## IMPROVEMENT OF UPPER COLUMBIA AND SNAKE RIVERS, OREGON AND WASHINGTON.

The project for the improvement of the upper Columbia and Snake rivers, and the results of operations in former years, are mentioned in the summary of this report.

No work of improvement was in progress during the fiscal year ending June 30, 1903, on the Snake River below Lewiston.

Congress, by act of June 13, 1902, appropriated the full amount estimated for the improvement of the Snake between Riparia and Lewiston, in accordance with the project published in House Document No. 127, Fifty-sixth Congress, second session, which project provided for dredging on the various gravel and bowlder shoals, and some dike work. Plans for a light-draft self-propelling dredge have been drawn and a contract for its construction is now pending. The project for this portion of the river provides for an expenditure of \$5,000 every

two years for maintenance and this sum should be provided and is included in the estimate of funds needed.

In addition to the necessary funds for the completion of the project of the improvement of the Snake below Lewiston, Congress in the same act appropriated \$25,000 for the improvement of the Snake between Lewiston and Pittsburg Landing, Oregon. As no estimate or detailed project had ever been made for the improvement of the Snake above Lewiston, a survey of the river between Lewiston and the mouth of the Imnaha River, 52 miles above, was authorized before outlining a plan of improvement. It was made by Mr. F. C. Schubert, junior engineer, who started from Lewiston September 20, 1902, with a party of 12 men and 3 batteaux. The party proceeded upstream by rowing and cordelling the boats against the current, and commenced the survey at the mouth of the Imnaha River. A transit and level line was run down the river to its junction with the Clearwater at Lewiston, topography of the river banks was taken, and the rapids, rocks, and obstructions to navigation located. During the time of the survey the gauge at Lewiston read from 0.4 to 0.8 of a foot above extreme low water. Soundings were taken in the river to give the low-water depth of the channel between the mouth of the Imnaha and Lewiston. The survey was completed by October 23, 1902.

A report of this survey and detailed project for the expenditure of the available funds, together with a map of the part of the river covered by it, in fourteen sheets, was forwarded under date of April 22, 1903, and is printed herewith in Appendix W W 14.

It was not thought expedient to carry the survey above the mouth of Imnaha River at the time as the low-water season was rapidly drawing to a close, and the chief need of improvement seemed to be below the mouth of that stream, and the only promise of navigation at present being confined to that stretch.

The survey indicated that the difficulties in the way of navigation between these points arose not so much from lack of depth as from the excessive slope of the stream with its consequent rapids and from many dangerous rocky points and bowlders. During the progress of the survey above Lewiston, 200 pounds of giant powder were expended by the party in blasting out a few of the most obstructive bowlders.

The approved project for the Snake now includes the river between Riparia and Imnaha and provides for the construction of a dredge to be paid for from available funds. No survey between Imnaha and Pittsburg Landing has yet been made and recommendation that this be deferred until further appropriations are made has been approved.

At the close of the fiscal year specifications are being revised covering a contract for the construction of a dredge by the Featherstone Foundry and Machine Company, of Chicago, Ill., for use on this work, their bid having been accepted, and it is hoped this dredge will be available for operations during the next low-water season.

As soon as the river falls to a stage low enough to allow of its being done, it is intended to send a small party up the river to blast out some of the most obstructive rocks and bowlders below the mouth of the Imnaha.

It is estimated that in addition to the available funds, about \$10,000 more will be required to complete the improvement of that part of the Snake between Lewiston and the mouth of the Imnaha, and this part of the river is considered worthy of improvement by the Government to that extent.

# 2220 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

## Money statement.

July 1, 1902, balance unexpended.....	\$52,544.41
June 30, 1903, amount expended during fiscal year .....	8,998.99
July 1, 1903, balance unexpended.....	48,545.42
{ Amount (estimated) required for completion of existing project.....	Indefinite.
Amount that can be profitably expended in fiscal year ending June 30, 1905, in addition to the balance unexpended July 1, 1903:	
For works of improvement.....	\$10,000.00
For maintenance of improvement .....	5,000.00
	15,000.00
{ Submitted in compliance with requirements of sundry civil act of June 4, 1897, and of section 7 of the river and harbor act of 1899.	

## APPROPRIATIONS.

Upper Columbia River, act of—	
June 10, 1872 .....	\$50,000.00
June 23, 1874 .....	20,000.00
March 3, 1875.....	35,000.00
	\$105,000.00
Upper Columbia and Snake Rivers, act of—	
August 14, 1876.....	15,000.00
June 18, 1878 .....	20,000.00
March 3, 1879 .....	20,000.00
June 14, 1880 .....	15,000.00
March 3, 1881.....	15,000.00
August 2, 1883.....	6,000.00
July 5, 1884.....	20,000.00
August 5, 1886.....	10,000.00
August 11, 1888.....	10,000.00
September 19, 1890.....	20,000.00
July 13, 1892.....	15,000.00
August 18, 1894.....	5,000.00
June 3, 1896.....	5,000.00
March 3, 1899.....	7,500.00
Upper Columbia and Snake rivers, act of—	
June 13, 1902 .....	40,250.00
June 13, 1902, balance transferred from improvement of Clearwater River, Idaho .....	12,294.41
	236,044.41
December 30, 1897, reimbursement for property.....	414.00
July 12, 1899, reimbursement for property .....	365.00
January 29, 1901, reimbursement for property .....	43.70
Aggregate.....	341,867.11

## COMMERCIAL STATISTICS FOR YEARS ENDING DECEMBER 31, 1901, AND 1902.

Articles.	1901.		1902.	
	Exported.	Imported.	Exported.	Imported.
Fruit.....	Tons. 1,729	Tons. 26	Tons. 1,006	Tons. 47
Grain.....	29,131	.....	31,245	88
Live stock.....	489	80	120	10
Lumber.....	401	836	84	1,310
Merchandise.....	1,386	2,277	765	2,310
Wool.....	431	.....	431	13
Total.....	33,554	3,169	33,661	4,173

The statistics for 1901 were not previously reported.

The Oregon Railroad and Navigation Company operates a regular line of steamboats in Snake River, between Riparia, Wash., and Lewiston, Idaho, connecting at Riparia with the Portland-Spokane rail line of that company. These steamboats make occasional trips for short distances below Riparia and above Lewiston when the river is at a favorable stage and sufficient freight is offered. There are four steamboats in the river, the *Lewiston*, *Imnaha*, *Spokane*, and *Norma*, the net tonnage of each being between 400 and 500, and their draft, fully laden, about 5 feet.

## W W 8.

### IMPROVEMENT OF COLUMBIA RIVER AT THREE-MILE RAPIDS, OREGON AND WASHINGTON.

Congress by act of June 13, 1902, approved a new project for overcoming the obstructions to navigation in the Columbia River between the foot of The Dalles Rapids and the head of Celilo Falls by canals with locks, in accordance with the reports submitted in House Document No. 228, Fifty-sixth Congress, second session, and provided for a reexamination of the project by a Board of Engineers with a view of lessening its cost.

The Board, appointed by paragraph 6, Special Orders No. 19, Headquarters Corps of Engineers, July 5, 1902, after visiting the site of the proposed works in September, 1902, requested certain additional information and estimates, in pursuance of which request soundings were made in Five-Mile Rapids, and a careful topographical survey was made of the site of the relief channel around Ten-mile Rapids on the Washington side. The Columbia River was carefully gauged at a point about  $7\frac{1}{2}$  miles below the town of The Dalles, both with floats and meter, from January 19 to February 24, 1903, at stages of the river varying from 11.1 to 2.2 above extreme low water. From these gaugings the discharge of the Columbia at the locality of the work at low water is estimated to be, approximately, 57,000 cubic feet per second.

In addition to the field work eight estimates of cost of eight different plans of overcoming the obstructions were made.

The Board at its second meeting, held in Portland, Oreg., May 11 to 14, 1903, after a consideration of the additional data collected, requested that a detailed survey of the ground for a continuous canal on the Oregon side, extending from above Celilo Falls to a point immediately below the foot of Five-mile Rapids, be made to procure reliable data to enable an accurate estimate of the cost to be made.

A survey party to do this work was sent into the field June 10, and is now engaged thereon.

The five river gauges between Celilo and The Dalles were reset in February and March, 1903, and have been read daily to the present time.

If a satisfactory project is adopted, and this work undertaken, it should be rapidly pushed and a large appropriation made. Subject to the above remarks it is thought that no less than \$500,000 additional should be provided, and this sum is therefore named in the money statement for expenditure to June 30, 1905.

This work was in the immediate charge of Mr. William E. Morris, assistant engineer, under supervision of Mr. James S. Polhemus, assistant engineer.

## 2222 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

*Money statement.*

July 1, 1903, balance unexpended.....	\$314,481.51
May 31, 1903, deposited, account refundment United States court .....	7,500.00
July 6, 1903, deposited, account refundment for right of way .....	1,030.66
	<u>322,963.17</u>
June 30, 1903, amount expended during fiscal year.....	14,469.15
July 1, 1903, balance unexpended.....	308,493.02
July 1, 1903, outstanding liabilities.....	218.00
	<u>308,275.02</u>
July 1, 1903, balance available .....	308,275.02
{ Amount (estimated) required for completion of existing project ....	Indefinite.
{ Amount that can be profitably expended in fiscal year ending June 30, 1905, in addition to the balance unexpended July 1, 1903 .....	500,000.00
{ Submitted in compliance with requirements of sundry civil act of June 4, 1897.	

## APPROPRIATIONS.

Act of—	
August 18, 1894.....	\$100,000
June 3, 1896 .....	150,000
Total.....	<u>250,000</u>

## W W 9.

## CANAL AT THE CASCADES, COLUMBIA RIVER, OREGON.

The project for overcoming the obstructions in the Columbia River at the Cascades, Oregon, and the results of operations in former years are mentioned in the summary of this report. Operations carried on during the past fiscal year were in accordance with the modified project adopted in 1894. They consisted in adding two courses of face stone, together with a stone coping, backed with concrete, to the north wall of the upper lock, the building of a stone stairway from the lock wall to the upper gate wall, the raising of the embankment separating the river and canal, and the protection of the river side of a portion of the embankment by riprapping it. The slope pavement near the upper guard gate was finished. This completed all of the projected work on the north side of the canal.

All of this work was performed under a contract with Hosea W. Taylor, of Cascade Locks, Oreg., dated November 10, 1902. He commenced work under the contract December 9, 1902, and completed the contract June 6, 1903.

The following items of work were done under the contract:

Stairway dimension stone, 23 cubic yards, at \$37.....	\$851.00
Coping, 230 cubic yards, at \$24.....	5,530.00
Face stone, 88.4 cubic yards, at \$24.....	2,121.60
Concrete, 492 cubic yards, at \$7.....	3,444.00
Wrought iron, 1,348 pounds, at 8 cents .....	107.84
Raising height of embankment, earth, 15,150 cubic yards, at 35 cents....	5,302.50
Fill behind lock wall, earth, 10,990 cubic yards, at 35 cents.....	3,846.50
Riprap, 1,814 cubic yards, at \$1.....	1,814.00
Slope pavement, 170 cubic yards, at \$2.75.....	467.50
Dry rubble, 36 cubic yards, at \$1.25.....	45.00
Total.....	<u>23,019.94</u>
Rent of plant.....	\$890.00
Supplies sold to contractor .....	40.37
	<u>930.37</u>
Total paid to contractor.....	<u>23,069.57</u>

During the fall of 1901 the small creek which supplies water for the maneuvering machinery of the locks through a 10-inch pipe tapping the creek at an elevation of 494 feet above the upper gate wall became dry at the intake. About three-fourths of a cubic foot of water per second would be required to make continuous lockages of one lockage every ten minutes. To insure a sufficient supply of water at all times, it was decided to extend a 5 and 6 inch pipe from the present intake about 1,700 feet farther up the stream. A trench had been dug for this pipe in 1902, and during the fiscal year the pipe was purchased and laid.

A few rocky points in the channel below the locks and opposite Sheridan Point were blasted out.

The removal of an obstructive rock in the rapids near the locks with a part of the last appropriation was authorized by the river and harbor act of June 13, 1902, and the proposals for doing the work being considered excessive all bids were rejected and this work deferred for the present.

The next important work is completion of the land wall of the lower lock. The earth bank is now used as the wall, and this, besides making lockages slower and unsatisfactory, is liable to be injurious to the work by bringing water pressure on the uncompleted lower wing wall and tending to cause a scour under it. To complete this wall will take at least \$100,000, and this sum should be appropriated.

Mr. W. G. Brown, junior engineer, was in local charge of operations until May 7, 1903, since which date Mr. W. L. Clark, inspector, has been immediately in charge.

For commercial statistics, etc., see report for "Operating and care of canal and locks at the Cascades of the Columbia River, Oregon."

#### *Money statement.*

July 1, 1902, balance unexpended.....	\$31,984.58
Deposit account, proceeds of sales of public property, January 5, 1903.....	6,100.00
	<hr/>
	88,084.58
June 30, 1903, amount expended during fiscal year.....	27,122.38
	<hr/>
July 1, 1903, balance unexpended.....	10,912.20
	<hr/>
Amount (estimated) required for completion of existing project.....	229,260.00
Amount that can be profitably expended in fiscal year ending June 30, 1905, in addition to the balance unexpended July 1, 1903.....	100,000.00
Submitted in compliance with requirements of sundry civil act of June 4, 1897.	

#### APPROPRIATIONS.

Act of—		Act of—	
August 14, 1876.....	\$90,000	March 8, 1893.....	\$1,239,653
June 18, 1878.....	150,000	June 3, 1896.....	50,000
March 8, 1879.....	100,000	June 11, 1896.....	179,597
June 14, 1880.....	100,000	March 8, 1899.....	75,000
March 3, 1881.....	100,000	June 18, 1902.....	80,000
August 2, 1882.....	265,000	January 5, 1903, deposited to credit of appropriation, account sales.....	6,100
July 5, 1884.....	150,000		
August 5, 1886.....	187,500		
August 11, 1888.....	300,000		
September 19, 1890.....	435,000		
July 13, 1892.....	326,250	Total.....	3,784,100

## 2224 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

CONTRACT IN FORCE FOR CUT STONE, CONCRETE, RUBBLE MASONRY, AND GRADING  
AT CASCADE LOCKS.

Name of contractor: Hosea W. Taylor.  
 Date of contract: November 10, 1902.  
 Date of approval: November 28, 1902.  
 Date of beginning: December 9, 1902.  
 Date of expiration: November 28, 1903. (Completed.)

---

W W 10.

OPERATING AND CARE OF CANAL AND LOCKS AT THE CASCADES  
OF THE COLUMBIA RIVER, OREGON.

The canal and locks around the Cascades of the Columbia River, about 150 miles above the mouth of the latter in the Pacific Ocean, and which, although incomplete, enable steamboats drawing 8 feet to run as far upstream as The Dalles, Oreg., about 200 miles above the mouth, were formally opened to navigation November 5, 1896.

During the past fiscal year the locks were operated continuously until June 6, when the river reached 39.4 feet on the upper gauge, and the current became so swift in the rapids below that the steamers were not able to stem it and reach the locks.

The operations during the past fiscal year, aside from the ordinary operation of the locks and dredging under contract, consisted in applying some sample paints to the steel lock gates to test their durability and protective qualities, and in dredging in the lower and upper canal entrances under contract.

The usual spring rise of the river being so near at hand, the contractors were granted an extension until after the time of high water.

Work under the contract with the Cascades Construction Company, in force at close of last fiscal year, for dredging canal entrances was resumed October 11, 1902, at the lower entrance. There were removed from this entrance 8,985 cubic yards. The dredge was then taken back to the upper entrance and 510 cubic yards removed which had accumulated since suspension of work in March, 1902. The contract was completed November 30, 1902. Under the contract 31,275 cubic yards of material were dredged from the upper entrance and 9,235 cubic yards from the lower entrance.

The work was under the immediate supervision of Mr. W. G. Brown, junior engineer, until May 7, 1903, since which date Mr. W. L. Clark, inspector, has been in local charge of the work.

*Money statement.*

July 1, 1902, balance unexpended.....	\$3,368.67
Allotment July 12, 1902.....	5,500.00
	<hr/>
	8,868.67
June 30, 1903, amount expended during fiscal year.....	6,840.31
	<hr/>
July 1, 1903, balance unexpended.....	2,028.36
July 1, 1903, outstanding liabilities.....	286.30
	<hr/>
July 1, 1903, balance available.....	1,742.06



## ALLOTMENTS.

November 4, 1896 .....	\$2,500.00	July 25, 1900 .....	\$11,121.41
May 21, 1897 .....	850.00	July 19, 1901 .....	2,248.68
August 21, 1897 .....	4,000.00	June 12, 1902 .....	5,500.00
October 30, 1897 .....	1,500.00		
July 26, 1898 .....	18,869.86	Total .....	44,182.17
July 22, 1899 .....	8,047.77		

## CONTRACT IN FORCE FOR DREDGING 27,500 CUBIC YARDS OF MATERIAL AT 25 CENTS PER CUBIC YARD.

Name of contractor: Cascades Construction Company.  
 Date of contract: October 9, 1901.  
 Date of approval: October 26, 1901.  
 Date of beginning: October 29, 1901.  
 Date of expiration: April 22, 1902.  
 Date of completion: November 30, 1902.  
 This contract was extended for a reasonable period, as authorized by the Chief of Engineers, U. S. Army, March 29, 1902.

*Detailed statement of expenditures for operating and care of canal and locks, Columbia River, Oregon, during the fiscal year ending June 30, 1903.*

Month.	Labor.	Materials for repairs.	Tools, fuel, oil, etc.	Superintendence and contingencies.	Total.
1902.					
July .....	\$175.00	-----	-----	\$265.00	\$440.00
August .....	175.00	-----	\$16.50	60.00	251.50
September .....	196.00	-----	-----	-----	196.00
October .....	228.22	-----	10.15	-----	238.37
November .....	198.00	-----	209.67	-----	407.67
December .....	190.00	-----	7.23	2,351.96	2,549.19
1903.					
January .....	190.00	\$306.75	20.20	-----	516.95
February .....	231.51	-----	-----	-----	231.51
March .....	190.00	-----	18.00	-----	208.00
April .....	190.00	-----	8.50	-----	198.50
May .....	207.00	-----	39.70	-----	246.70
June .....	190.00	-----	-----	142.50	332.50
Total .....	2,355.78	306.75	329.95	2,519.46	5,512.89

*Summary of expenditures made on operating and caring for canal and locks, Columbia River, Oregon, during the fiscal year ending June 30, 1903, submitted in compliance with river and harbor act of July 5, 1884.*

Items of estimate.	Amount.
Labor .....	\$2,355.78
Materials for repairs .....	306.75
Tools, fuel, oil, etc .....	329.95
Office expenses, superintendence, and contingencies (including dredging) .....	2,519.46
Total .....	5,512.89

## 2226 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

## COMMERCIAL STATISTICS.

*Canal at Cascades, Oregon—Summary of business, etc., during fiscal year ending June 30, 1903.*

Month.	Average gauge readings, 12 m.		Number of lock-ages.	Locks operated.	Number of passages.			
	Upper.	Lower.			Stern-wheel.	Pro-peller.	Barge or sail.	Total.
1902.								
July.....	114.9	100.5	110	<i>h. m.</i> 26 26	118	1	-----	114
August.....	106.9	88.9	137	27 14	153	1	-----	154
September.....	100.9	79.5	122	23 03	133	-----	-----	133
October.....	97.8	74.9	133	27 16	139	-----	-----	139
November.....	98	75.3	121	29 12	133	-----	-----	133
December.....	98.1	75.5	110	22 37	122	1	-----	123
1903.								
January.....	100.7	79.3	117	22 36	123	1	1	120
February.....	98.2	75.3	58	10 43	61	-----	-----	61
March.....	98.9	76.7	66	12 06	66	-----	-----	66
April.....	105	85.3	58	10 36	56	2	-----	58
May.....	110.9	95	78	21 20	75	3	-----	78
June.....	126.6	113.3	17	4 30	17	-----	-----	17
Total.....	-----	-----	1,127	237 42	1,196	9	1	1,206

Month.	Registered tonnage.	Freight carried.	Passen- gers.	Vessels delayed.	
				Number.	Minutes.
1902.					
July.....	28,935	Tons. 1,203.25	Number. 7,590		
August.....	37,860	2,732.25	10,645	2	30
September.....	32,612	3,659.25	6,333		
October.....	33,537	5,639.75	4,049		
November.....	32,434	4,605	3,069		
December.....	28,945	2,324	2,957		
1903.					
January.....	30,703	3,274	2,590		
February.....	17,221	990.25	2,023		
March.....	16,321	2,511.75	2,419		
April.....	12,317	2,164	2,793		
May.....	23,293	5,994.75	4,704		
June.....	5,693	1,018.00	1,699		
Total.....	300,431	36,181.25	50,321	2	30

*Statement of traffic passing through canal at Cascades, Oregon, during fiscal year ending June 30, 1903.*

Month.	Bound up.							
	Coal.	Miscel-laneous grain.	Hay.	Cattle.	Horses.	Sheep.	Miscel-laneous live stock.	Berries and fruit.
<b>1902.</b>								
July.....	Tons.	Pounds.	Tons.	No.	No.	No.	No.	Pounds.
August.....	10,000	8	15	43	100	-----	-----	-----
September.....	3,000	31	54	16	151	40	2	-----
October.....	-----	110	43	154	78	8	1,500	-----
November.....	2,640	75.25	241	120	925	6	500	-----
December.....	6,000	72.75	25	46	-----	-----	1,000	-----
<b>1903.</b>								
January.....	10,000	18	71	23	-----	-----	500	-----
February.....	-----	27.50	5	79	-----	-----	-----	-----
March.....	-----	24	41	134	-----	-----	2,500	-----
April.....	8,400	61.50	120	135	-----	-----	1,800	-----
May.....	733.25	8,000	22.25	78	181	-----	-----	-----
June.....	-----	14.50	6	33	-----	-----	-----	-----
<b>Total.....</b>	<b>733.25</b>	<b>43,040</b>	<b>459.75</b>	<b>736</b>	<b>1,327</b>	<b>1,041</b>	<b>16</b>	<b>7,800</b>

2,087,701

*Statement of traffic passing through canal at Cascades, Oregon, during fiscal year ending June 30, 1903—Continued.*

Month.	Bound up.			Bound down.				
	Miscellaneous merchandise.	Total cargo.	Passengers.	Wheat.	Flour.	Miscellaneous grain.	Hay.	Cattle.
1902.	<i>Tons.</i>	<i>Tons.</i>	<i>No.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Tons.</i>	<i>No.</i>
July .....	519	742.75	4,045	24,000	180,550	44,000	-----	9
August .....	705.25	2,055.50	5,321	374,800	133,320	98,000	-----	5
September .....	577	1,217.50	2,924	2,961,800	204,760	100,000	1	242
October .....	971.25	1,584.25	1,764	5,523,100	139,000	224,200	2	236
November .....	2,499.50	3,076	1,361	921,000	227,900	196,100	-----	79
December .....	1,552.50	1,714.75	1,299	218,000	59,500	110,000	-----	14
1903.								
January .....	2,372.25	2,558.50	1,179	510,000	145,900	198,800	-----	9
February .....	370.75	543.50	974	90,000	83,800	86,000	-----	1
March .....	1,558.50	1,814.50	1,303	194,000	29,000	74,000	-----	34
April .....	700	1,138	1,476	932,700	111,000	41,800	-----	94
May .....	888.50	1,351	2,743	6,889,500	819,500	181,000	3	93
June .....	204.25	261.75	973	1,126,000	98,500	20,000	-----	-----
Total .....	12,838.75	18,508	25,387	19,784,500	1,883,180	1,321,400	6	516

Month.	Bound down.						
	Horses.	Sheep.	Miscellaneous live stock.	Berries and fruit.	Lumber.	Miscellaneous merchandise.	Passengers.
1902.	<i>Number.</i>	<i>Number.</i>	<i>Number.</i>	<i>Pounds.</i>	<i>Ft. B. M.</i>	<i>Tons.</i>	<i>Number.</i>
July .....	122	-----	-----	19,550	500	236.25	3,426
August .....	143	481	2	127,300	6,000	247	5,324
September .....	256	3,616	2	114,900	1,800	289.75	3,409
October .....	339	7,175	69	161,500	20,000	364	2,225
November .....	290	4,275	164	81,050	10,500	373	1,708
December .....	113	1,200	-----	51,000	-----	243.25	1,656
1903.							
January .....	129	-----	-----	18,000	-----	122.75	1,411
February .....	125	-----	-----	41,500	-----	241.25	1,054
March .....	155	-----	-----	60,500	600	408.50	1,116
April .....	141	-----	-----	20,600	-----	342.25	1,322
May .....	264	1,355	80	7,000	-----	181.25	1,961
June .....	88	450	-----	-----	1,000	55	721
Total .....	2,190	18,502	237	702,900	40,400	3,179.25	25,454

*List of vessels passing through canal at the Cascades, Columbia River, Oregon, during fiscal year ending June 30, 1903.*

Name.	Character.	Length.	Breadth.	Depth of hold.	Net tonnage.	Number of times passed through canal during fiscal year.
		<i>Feet.</i>	<i>Feet.</i>	<i>Feet.</i>		
Bailey Catzert..	Stern-wheel steamboat.....	177.3	32.3	8	444	20
Carlin .....	Propeller steamboat.....	-----	-----	-----	-----	1
Dalles City .....	Stern-wheel steamboat.....	150	30.9	8.2	323	294
Elmore .....	do .....	180	34	4.5	467	3
Glenola .....	do .....	139.6	28.2	5.4	276	71
Hercules .....	do .....	160.3	34	8.6	293	157
Katie Weir .....	Propeller steamboat.....	41	9.8	3.5	5	1
Maja .....	do .....	54.1	13.1	5.4	22	1
Metlako .....	Stern-wheel steamboat.....	109	24.4	4.8	122	180
Regulator .....	do .....	157	34.4	7.7	306	239
Resolute .....	Propeller steamboat.....	53	12.5	5	13	2
Sadie B .....	do .....	80	15	4.7	83	2
Stranger .....	do .....	-----	-----	-----	-----	1
Tahoma .....	Stern-wheel steamboat.....	117.5	27	6	154	243
Water Witch .....	Propeller steamboat.....	-----	-----	-----	-----	1
Barge .....	-----	-----	-----	-----	-----	1
Total .....	-----	-----	-----	-----	-----	1,203

## 2228 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

*Meteorological and gauge records for the year.*

Month.	Rainfall.	Days on which rain or snow fell.	Average temperature at 12 m.	Highest reading of gauges.		Lowest reading of gauges.	
				Head of canal.	Foot of canal.	Head of canal.	Foot of canal.
1902.	<i>Inches.</i>		<i>° F.</i>				
July.....	1.51	10	75.8	118	104.2	111.8	95.8
August.....	.27	2	79.6	110.9	95.2	104	84.3
September.....	3.09	6	72.4	108.9	84.1	98.9	76.6
October.....	2.69	18	64.8	98.8	76.5	97.2	74
November.....	21.01	24	48.1	98.9	76.6	97.2	74
December.....	19.83	23	38.1	98.9	76.7	97.1	73.9
1903.							
January.....	17.28	21	43	104.6	85.4	98.8	75.6
February.....	2.47	6	44	100.9	79.6	96.9	73.8
March.....	3.89	13	52.7	105.2	86.1	97.1	74.1
April.....	2.84	18	57.9	108.8	90.8	103.2	82.9
May.....	2.52	18	69.9	118.6	98.2	107.9	90.2
June.....	4.63	13	74.5	120.8	118	114.4	99.2
Total.....	82.08	167	60				

Highest reading at head of canal during the year ..... 120.8

Highest reading at foot of canal during the year ..... 118

Lowest reading at head of canal during the year ..... 96.9

Lowest reading at foot of canal during the year ..... 73.8

NOTE.—Reading of adopted low water at head of canal is 96; reading of adopted low water at foot of canal is 72.

## W W II.

## IMPROVEMENT OF COLUMBIA RIVER BETWEEN VANCOUVER, WASHINGTON, AND MOUTH OF WILLAMETTE RIVER.

The only operations carried on during the fiscal year ending June 30, 1903, were in connection with maintaining the existing dike by riprapping it at several weak points with rubblestone.

After the flood of the summer of 1902 had receded an examination of the dike and revetment showed them to be practically uninjured, the only change being a slight settlement of the brush and stone filling at several places along the main dike. The weak spots were strengthened by the depositing thereon of 635 cubic yards of rubblestone, which was delivered on the dike by the Hale & Kern Contract Company, under emergency contract dated November 12, 1902. The company commenced the delivery of stone November 28, 1902, and completed the work December 8, 1902.

No soundings were taken over the shoals between Vancouver and the mouth of the Willamette River during the year, but masters of steamboats report a very slight increase of depth. It is estimated that about \$10,000 will be required every two years to maintain the dike and the island revetment in its present condition, by placing brush fascines and rubblestone on the dike and revetment to offset settlement and injury which may be caused by high waters.

At this time this work is not considered unworthy of improvement to the extent of maintaining the existing work.

*Money statement.*

July 1, 1902, balance unexpended.....	\$2,237.66
June 30, 1903, amount expended during fiscal year .....	1,603.85
July 1, 1903, balance unexpended.....	634.01
<hr/>	
{ Amount that can be profitably expended in fiscal year ending June 30, 1905, for maintenance of improvement, in addition to the balance unexpended July 1, 1903.....	10,000.00
{ Submitted in compliance with requirements of sundry civil act of June 4, 1897, and of section 7 of the river and harbor act of 1899.	

## APPROPRIATIONS.

Act of—	
July 18, 1892.....	\$33,000
June 8, 1896.....	67,000
June 6, 1900 (allotment of June 18, 1901).....	8,000
February 2, 1900, refundment of overpayment.....	1
June 18, 1902.....	2,000
Total.....	110,001

## EMERGENCY CONTRACT FOR FURNISHING AND PLACING 600 CUBIC YARDS, MORE OR LESS, RIPRAP STONE IN DIKE.

Name of contractor: Hale & Kern Contract Company.  
Date of contract: November 12, 1902.  
Date of beginning: December 2, 1902.  
Date of expiration: February 1, 1903. (Completed.)

## W W 12.

## EXAMINATION AND SURVEY OF SIUSLAW RIVER, OREGON, AT ITS MOUTH AND AT THE SHOALS AT OR NEAR FLORENCE.

WAR DEPARTMENT,  
ENGINEER OFFICE, UNITED STATES ARMY,  
Portland, Oreg., February 5, 1903.

GENERAL: The river and harbor act of June 13, 1902, contained the following provision:

Improving mouth of Siuslaw River, Oregon: Continuing improvement, thirty-five thousand dollars, and the Secretary of War is authorized and directed to cause to be made a reexamination and survey of said river at its mouth and at the shoals at or near Florence, with a view to the adoption of a project for the improvement of said river which will provide for its commerce at a less cost than the existing project.

This work was assigned to this office by letter from Office Chief of Engineers dated June 20, 1902, and I have the honor to respectfully submit the following report and estimates in compliance therewith:

The present project for improvement of mouth of Siuslaw River, Oregon, was prepared by a Board of Engineers under date of June 11, 1891, and approved by the then Chief of Engineers July 17, 1891. This project is printed in Annual Report Chief of Engineers, 1891, pages 3175-3182. The estimated cost of the work proposed by the Board

was \$700,000, of which a total of \$187,000 has been appropriated. The works were designed to give 8 feet at mean lower low water on the bar. Nothing less than this would be satisfactory, and this depth is, therefore, regarded as necessary to accommodate the commerce of the river. On February 1, 1903, the balance available for the works is approximately \$32,065.90. The expenditures have been for the construction of about 4,090 feet of the north jetty, which includes a tramway approach 3,029 feet long at the shore end. On Sheet A herewith are shown the present state of the mouth of the river and the location of the jetties proposed by the Board, with the part of the north jetty so far as constructed indicated. On Sheet B herewith is a tracing of the map of 1899. Sheet C herewith is a map of 1889 upon which the report of the Board above mentioned is based, and shows the state of the river in that year and the plan of the Board. Building the north jetty first necessitated carrying it across the channel of the river and has rendered the construction of the last 500 feet very expensive, the whipping of the water around the end of the work scouring the bottom to depths of 40 to 50 feet. This jetty has now progressed so far that this tendency is diminishing, as shown by comparison of Sheets A and B, but it is evident from Sheet A that for some considerable distance farther more or less of this scouring will still occur as the jetty advances.

The following description of the mouth of the Siuslaw is taken from the report of the Board above referred to:

The course of the Siuslaw is westerly until a point just below the town of Florence is reached, when it turns to the north and flows for about 8 miles nearly parallel to the seashore, from which it is separated by a high ridge of bare sand dunes about a half mile in width.

The eastern or right bank of the river along this portion of the course is a bluff from 30 to 150 feet high. Up to the height of mean tide this bank is a mixture of clay and sand so hard as to offer an effectual resistance to the action of the water. The top of this is overlaid with a thin layer of decayed vegetable matter, in which are found roots and stumps of trees of considerable size, showing plainly that there was once here an extensive plain thickly covered with large trees. The whole of this for many miles in extent is now covered with sand dunes from 50 to 150 feet high. Upon these sand dunes there is a thick growth of small pines and ferns and other plants.

To the north of the northern end of this sandy peninsula, limiting the river on the west, the river flows to the ocean. From the end of the peninsula to the extreme northern position occupied by the channel is a distance of 1 mile. Over this space of a mile the channel wanders in an approximately regular cycle of seven to eight years about as follows:

Let us suppose the channel in its most northern position, where it is at present, and which is just about as shown on the Coast Survey chart of 1883. When the channel is in this position the bar channel is at its poorest, with about 5 feet at low water, owing to the waste of waters spilling over the spit, which extends for about three-fourths of a mile from the end of the sand peninsula to the position of the channel. The feeble action of the waters on the bar enables the ocean swells to pile up the sand on the bar, and the channel outside the spit trends to the southward.

Resistance enough finally accumulates in the northward position to cause a tendency in the waters to break across the spit just north of the end of the sand peninsula. As this southern opening enlarges more water escapes by it, and less by the northern, where the scouring action of the currents becomes weaker and weaker. Finally the south channel is fully opened and the north channel is closed, the sands accumulating and forming a spit, which tails down from the north, separated from the mainland by a lagoon occupying the position of the former channel. This lagoon is shown on the Engineer Department map of 1899.

This south channel is generally developed quite suddenly.

When the channel is in this position it is at its best.

From this position the channel moves north, eating into the north spit and being followed up in the bend by the south spit, and this goes on until the condition with which we started is reached and the cycle completed.

Eight miles to the north of the mouth of the Siuslaw, Hecata Head, a rocky point juts into the ocean. Twenty miles to the south the Umpqua River, limited on the south by a rocky headland, enters the ocean. Between these points there is a wide waste of sand dunes, with a seashore which is almost a perfectly straight line. This shore slopes off gradually into the sea, giving a wide shallow beach on which breakers form at considerable distance outside.

It is through this wide stretch of constantly shifting sands that the river struggles to effect an entrance to the ocean, the ocean beating the sands back while the accumulating waters of the river carry them out again.

The work so far done has fixed the channel in position where it breaks through the beach, but the outer part still varies through a considerable arc, the position of the outer end depending on weather effects. It also seems evident from the facts set forth in the above quotation that there is a decided movement of sand from south to north and also from north to south, with perhaps a preponderance of movement in the former direction. During flood tide, as the flat on the south side of the entrance becomes covered, quite a current sets in across it. Schooners of light draft have frequently ran on this spit and then worked their way across it into the river during high tide following.

The estimate of the Board of 1891 was \$700,000, but experience has shown that, allowing for all contingencies except losses caused by lack of funds, the completed cost of the present project will be less than this sum. Based on the best estimate that can be made of the probable depths in which the north jetty would have to be built, as it progressed, the cost of the present project, in round numbers, is, including previous expenditures to January 1, 1903:

First, for north jetty .....	\$426,934.10
Second, for south jetty .....	156,800.00
Total .....	583,284.10

Details of this estimate are given in Appendix I. It should be noticed that a new location is selected for the receiving wharf for the south jetty, saving a small sum by consequent shortening of the tramway. The new location is believed to be equally suitable.

It would seem, however, that the intent of the law was to ascertain whether a practicable plan could not be substituted for present one, that, while assuring the same contemplated results, would cost less. From this point of view the following is submitted:

A comparison of the maps herewith shows that while, as before stated, the main or resultant movement of sand may be from south to north along the beach, there is also a countermovement at times from north to south. If the northward movement is prevented the southern one will come into evidence. This is shown by the filling that has taken place behind and to the north of the north jetty. Hence, if the south jetty were built first, it is believed that the temporary cutting off of the supply of sand from the south by that portion, especially between high and low water mark, will allow the northern spit to extend southward and envelop the present end of the north jetty, causing the channel through the beach to shift southerly. Such an effect would reduce the depths in which the north jetty would be built, thus saving in cost. How much this will be is problematical, and no data for estimates from the nature of the case can be obtained, but that it will be considerable seems beyond question. This, then, is one method of reducing the estimated cost of the present project; that is, to construct the south jetty first and then the north, though the amount of saving can not be foretold. The possibility of laying a thick mattress from boats in advance of the north jetty to prevent scour, should

its construction first be continued, was studied, but in view of the plant required and the difficulties of the location it is not believed that any saving could be made.

But considering Sheet A and the Board's plan as laid down therein, experience with jetties on sandy shores would seem to lead to the conclusion that the lengths contemplated will be insufficient to accomplish the end desired, though this is but a fixed channel 8 feet deep at low tide across the bar. It is believed that the relatively deep pocket in which the outer ends would terminate if depths remained unchanged will fill up, and that the shoaler water outside this pocket will become still shoaler. In other words the jetties would have to be prolonged not less than 700 feet each. This would add to the cost of the present project \$116,200 for each jetty, or make the total estimated cost for both jetties, including previous expenditures (Appendix I), \$815,634.10. That this pocket of deep water is probably not permanent is evidenced by the fact that neither the Board's map of 1891 nor the map of 1899 gives any indication of it.

If the state of the river as it at present exists only is considered, it is not thought that a study of the problem would lead to jetties coincident, or nearly so, with those of the present project, admitting fully that the latter was the best plan under conditions existing in 1891. The project contemplated rapid and continuous work. This was not possible for evident reasons, and an entirely different state of affairs is now to be reckoned with.

It is believed, therefore, that the location of the jetties should be changed, and the possibility, in view of the limited depth proposed on the bar, of needing but one jetty considered. After careful consideration a single jetty was laid down on the north side of the channel and the best location seemed to be as shown on Map A. Starting from the point A on the constructed part of the present north jetty, it runs on a curve with a radius of 6,780 feet to the point B, the projected end. At this point a tangent to curve will be parallel to the outer straight portions of Board's jetties, thus providing for future extension should this ever become desirable. The estimated total cost of this jetty alone is \$263,100 (Appendix II<sup>a</sup>).

It is believed that this location of the jetty possesses the following advantages:

(a) It is cheaper to build on account of the lesser depths through which it passes.

(b) Its curved form will tend to keep the channel near it, a tendency which will be reenforced by the sand movement to the northward already spoken of. The curvature, however, is so gentle that no danger of a too narrow and very deep channel right alongside the jetty is anticipated. It is believed that a channel of practicable width and of the required depth will be secured and maintained in a fixed position.

(c) The very greatly reduced amount of sand that will have to be moved to obtain the required channel under that which would have to be disposed of by continuation of the Board's plan is evident; in other words, it disturbs natural conditions much less.

(d) A second, or south jetty, is still possible, and one is indicated on the map, should the result of the north jetty not be satisfactory. This south jetty is laid out with similar provision for extension. Its estimated cost is \$168,700. The total cost of both jetties is then \$431,800, and to include previous expenditures, \$586,734.10. Suppos-

<sup>a</sup>Not printed.



ing, therefore, for the moment that both jetties will be necessary, their combined cost, including previous expenditures, is still no greater practically than that of the Board's plan, unless some saving in the latter plan is made by constructing the south jetty first, and much less than this latter plan will cost, if, as indicated before, their lengths have to be increased over those projected by the Board. Suitable high beacons should be placed along the jetties at intervals to mark their positions.

An objection to this new plan would seem to be that it leaves projecting into the channel the outer portion of the north jetty from A to D, which portion becomes useless. But it is believed that this projecting end will not interfere with navigation and will not have to be removed. No estimate for this is, therefore, given.

But the objection may be raised to this plan that it contemplates a single jetty on the lee side of the entrance. (See Paper No. 910, Transactions, Am. S. C. E., Vol. XLVI, 1901, with discussions.) An alternate plan is, therefore, suggested, requiring two jetties, the main jetty on the windward or southern side of the channel combined with a shorter north jetty to direct the current properly into the concavity of the other. This plan is also indicated on sheet A, and either or both jetties can be prolonged any reasonable distance that may be found necessary. The concavity at the outer end of the longer jetty is suggested for two main reasons: (a) To allow the sand to pass around the end and up the coast with as little interference as possible; and (b) to hold the current as it comes from the shorter north jetty and maintain the channel fixed in its immediate vicinity. From the inner end of the south jetty to the point marked K it is proposed to keep the jetty low. The part across the south spit will be only a thin layer of rock to protect the piling of the tramway. For the remainder of the distance to K the height will be kept at about mean low water. From K to the outer end the jetty is to be maintained to as near mean high water as may prove economically practicable. The short north jetty is to be built throughout its length only to mean low water. If, after trial, it is deemed necessary, either or both jetties can be raised or lengthened. The object of this plan is to interfere as little as may be with natural sand movements and at the same time concentrate on the shoal portion of the bar sufficient discharge to maintain the desired depth of navigable width fixed in position. Suitable high beacons will be placed along both jetties at intervals to mark their positions. The estimated cost of this south jetty is \$168,700, and of the shorter north jetty \$148,700, or a total of \$317,400. Adding in previous expenditures, the total cost of this plan is then \$472,334.10 (Appendix III<sup>a</sup>).

Attention is invited to the large area of shifting sand which forms the west bank of the river. This sand is light, easily moved by the winds, and enormous quantities are blown into the river. It is believed that a most important step in the work is one looking to fixing this sand in position by means of sand-binding grasses. Similar work has been started at Coos Bay and so far is very successful. A trial is now being made at the mouth of Columbia River. This work will be somewhat costly, but well worth, where successful, all it costs. At least \$10,000 should be allotted for this work as a beginning, and if successful further allotments should be made. This need not all be spent in one year, but could well be distributed over, say, three years. This expense is covered in the 20 per cent contingencies.

---

<sup>a</sup> Not printed.

In regard to work of improvement needed "at the shoals at or near Florence," on sheets A and D herewith are shown the present condition of two shoals on which there are less than 10 feet of water at low tide. The lower one, about 9,000 feet below Florence, has a navigable channel through it of not less than 9 feet depth. The upper, about 7,000 feet above Florence, has minimum depths of only 7 and 8 feet. To dredge a channel to 10 feet depth and 200 feet in width through these shoals will cost approximately \$29,500. It is beyond question that these or similar shoals formed elsewhere will have to be periodically redredged. Assuming a deterioration of 15 per cent per year, the approximate annual cost of maintenance of the channel in the river will be about \$4,500. Experience may show that jetties may be more economical in some portions of the river below Florence—that is, the shoals may be so permanent in location that permanent works may be worth undertaking. At present it is not believed prudent to make any estimates looking to such works, as the information available is insufficient.

The conclusions of this report may be summarized as follows:

(a) That the estimated cost of completing the project of 1891, according to present plan of constructing the north jetty first and then the south jetty, is \$428,300.

(b) That a reduction of uncertain amount will be made in this cost if the south jetty is constructed first. A small saving in any event will be made by changing the location of the receiving wharf for the south jetty.

(c) That if the project of 1891 is carried out an increase in the lengths of both jetties may be necessary, and increase the cost from \$428,300 to \$660,700.

(d) That there is a strong probability that a single north jetty, in different place, as indicated on the map herewith and of the approximate length there shown, will obtain the results desired, i. e., fix the bar channel in position and obtain and maintain the low-water depth projected. The estimated cost of this jetty is \$263,100. Should a south jetty be found necessary it can be built approximately as indicated on the map for \$168,700, making the total cost of the two jetties \$586,734.10, with previous expenditures.

(e) As an alternate to the plan just given, a long jetty on the south, slightly concave at the outer end, with a shorter north jetty to direct the current, is also suggested as preferable and cheaper to carry out than the 1891 plan. The estimated cost of this alternate plan is \$317,400, or \$472,334.10 with previous expenditures.

(f) Each of the plans indicated respectively in subparagraphs (d) and (e) has advantages peculiar to itself, and it is believed that either could be adopted with successful results. Should the two jetties be required in the first of these plans, the second would prove cheaper, and, in any event, on account of its offering less interference with natural conditions, it seems preferable, and is recommended for adoption as the project for the improvement of the bar.

(g) That dredging of two shoals at and near Florence to a depth of 10 feet for a width of 200 feet is all the work at present needed in the river inside the bar. This dredging will cost \$29,520, and there will be required for maintenance an average annual sum of \$4,500.

(h) That a serious attempt should be made to fix the shifting sands with sand-binding grasses.

(i) That the projected depth of 8 feet on the bar in a fixed channel of sufficient width and of 10 feet across the shoals in the river at and

near Florence will accommodate the present and prospective commerce of the river.

Very respectfully, your obedient servant,

W. C. LANGFITT,  
*Captain, Corps of Engineers.*

Brig. Gen. G. L. GILLESPIE,  
*Chief of Engineers, U. S. Army.*

[First indorsement.]

U. S. ENGINEER OFFICE, NORTHERN PACIFIC DIVISION,  
*San Francisco, Cal., February 24, 1903.*

Respectfully forwarded to the Chief of Engineers, U. S. Army.

After studying project herein, I fear that low jetties at the locality might be dangerous, and submitted my views on the matter to Captain Langfitt, which are herewith in Appendix A<sup>a</sup>. Captain Langfitt's views thereon are expressed in Appendix B<sup>a</sup> herewith.

Paragraph 8, Appendix A, states my views as to the requirements of the situation. The south jetty, it seems to me, ought to be at least 700 to 800 feet distant from the north at its outer end, for if placed nearer it is possible that the channel formed may be too contracted, the depth considerably greater than necessary, and that one or the other of the jetties may be undermined. Opposite the root of north jetty and in the river proper, where widths less than 700 feet exist, the depths exceed 20 feet.

W. H. HEUER,  
*Lieut. Col., Corps of Engineers,  
Division Engineer.*

[Second indorsement.]

OFFICE CHIEF OF ENGINEERS,  
U. S. ARMY,  
*March 10, 1903.*

Respectfully referred to the Board of Engineers for Rivers and Harbors, constituted by Special Orders, No. 24, Headquarters Corps of Engineers, series of 1902, for consideration and recommendation. By command of Brigadier-General Gillespie.

A. MCKENZIE,  
*Colonel, Corps of Engineers.*

[Third indorsement.]

BOARD OF ENGINEERS FOR RIVERS AND HARBORS,  
*Washington, D. C., March 26, 1903.*

Respectfully returned to the Chief of Engineers, U. S. Army, inviting attention to the accompanying report.

For the Board:

H. F. HODGES,  
*Major, Corps of Engineers,  
Senior Member Present.*

#### REPORT OF THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS.

WASHINGTON BARRACKS,  
*Washington, D. C., March 26, 1903.*

GENERAL: The river and harbor act of June 13, 1902, contains the following item:

Improving mouth of Siuslaw River, Oregon: Continuing improvement, thirty-five thousand dollars; and the Secretary of War is authorized and directed to

<sup>a</sup> Not printed.

cause to be made a reexamination and survey of said river at its mouth, and at the shoals at or near Florence, with a view to the adoption of a project for the improvement of said river, which will provide for its commerce at a less cost than the existing project.

The examination and survey were made by the district officer, Capt. W. C. Langfitt, Corps of Engineers, and his report was referred to the Board of Engineers for Rivers and Harbors by second indorsement March 10, 1903. After considering it at three meetings the Board has the honor to report as follows:

The existing project for the improvement of the mouth of Siuclaw River was prepared by a Board of Engineers in 1891, and approved by the Chief of Engineers July 17, 1891. The estimate of the cost of this project was \$700,000. The district officer estimates that the projected jetties can now be built for \$583,234, including \$154,934.10 already expended. He believes, however, that to secure the desired depth (8 feet) the jetties will have to be extended 700 feet farther than contemplated in the original project, and that this extension will cost \$116,200 for each jetty, making the total cost of the improvement \$815,634.10. In this the Board concurs.

The district officer expresses the opinion that under present conditions it is not advisable to adhere to the lines laid down in the original project, and the Board agrees with him.

Two new locations for the jetties are suggested by the district officer, viz: (1) A B and E H and (2) A J and E K H on the map accompanying his report. Of these the Board prefers the former, but believes that the exact width between the jetties at their outer ends should be left to be determined by the district officer from the results obtained as the work progresses.

The Board agrees with the district officer that there is a reasonable probability that the construction of a high tide jetty on the line A B will secure the projected depth.

If it be the will of Congress to continue this improvement the Board recommends:

(a) That a jetty with its crest at mean high water be built on the line A B.

(b) That a jetty of similar height be built approximately on the line E H, if at any time during the progress of work on A B, or thereafter, the need of this south jetty should become apparent.

(c) That should it become necessary to construct a south jetty, the width of opening between the jetties at their outer ends be determined from conditions then existing.

(d) That to carry the projected depth (8 feet) to Florence, as called for by the act of June 13, 1902, the dredging recommended by the district officer be done.

(e) That sand binding grasses be planted, as recommended by the district officer.

The cost of completing the work as above outlined is estimated by the district officer as follows:

North jetty.....	\$263,100
South jetty.....	168,700
Dredging.....	29,520
<b>Total.....</b>	<b>461,320</b>

These figures include 20 per cent for engineering and contingencies. This is believed to be sufficient to cover any expense that may

be incurred for sand binding grasses, etc.; \$154,934.10 has been expended up to this time in building the existing portion of the north jetty. Including this amount the total estimated cost of the improvement will be \$616,254.10.

The last annual report of the Chief of Engineers states that—

The commerce of the Siuslaw River is limited at present, the country being but thinly settled. There is much timber in the vicinity, and lumber is the principal article of commerce at the present time. It is taken from the river to San Francisco in coasting vessels. The river and ocean form the only means of transporting the commerce to market, there being no railroad in the vicinity.

The statistics from 1892 to 1901 show an annual commerce, incoming and outgoing, which varies between 2,381 and 22,351 tons, with no uniform increase. The town of Florence, which appears to be the most important point on the river, is reported in the census of 1900 as having a population of 222.

The improvement, if carried out, may cost \$461,320, in addition to the sums already expended. It is designed to produce a bar depth of 8 feet, or 2 feet increase over the present depth. One of the chief present complaints is that vessels trying to enter or leave the harbor may be bar bound for long periods. It is not apparent that the small projected increase in depth would make the bar channel navigable at all times, or would even greatly reduce the periods during which it would be impassable.

The present commerce of the Siuslaw River is insignificant. The prospective commerce, if carried on a bar depth of only 8 feet, would not probably be great enough to warrant the execution of the costly work proposed. At the mouth of the Umpqua River, only about 20 miles to the south of the Siuslaw, there is a natural bar depth of nearly 13 feet at low water, with practically similar if not superior promise of commerce; yet this depth has not sufficed to create or maintain a trade which would warrant an expenditure such as would be required to produce only 8 feet at the Siuslaw bar. A considerable increase of depth over 8 feet, without which no extensive trade would probably be developed, would increase the cost of the project, and is therefore put out of present consideration by the law ordering the reexamination, which contemplates a reduction in cost.

The act constituting the Board requires that it shall submit to the Chief of Engineers recommendation as to the desirability of commencing or continuing any and all improvements upon which reports are required. Complying with this provision of the law, the Board reports that in its opinion it is not desirable to continue the improvement of the Siuslaw River with the view of obtaining a depth of 8 feet.

Respectfully submitted.

A. MACKENZIE,  
*Colonel, Corps of Engineers.*

H. F. HODGES,  
*Major, Corps of Engineers.*

EDW. BURR,  
*Major, Corps of Engineers.*

C. H. MCKINSTRY,  
*Captain, Corps of Engineers.*

W. V. JUDSON,  
*Captain, Corps of Engineers.*

Brig. Gen. G. L. GILLESPIE,  
*Corps of Engineers, U. S. A.*

## LETTER OF THE CHIEF OF ENGINEERS.

OFFICE OF THE CHIEF OF ENGINEERS,  
UNITED STATES ARMY,  
*Washington, April 10, 1903.*

SIR: The river and harbor act approved June 13, 1902, contains the following provision:

Improving mouth of Siuslaw River, Oregon: Continuing improvement, thirty-five thousand dollars, and the Secretary of War is authorized and directed to cause to be made a reexamination and survey of said river at its mouth, and at the shoals at or near Florence, with a view to the adoption of a project for the improvement of said river which will provide for its commerce at a less cost than the existing project.

The examination and survey thus authorized has been made, and report thereon, submitted by Capt. W. C. Langfitt, Corps of Engineers, under date of February 5, 1903, is herewith.

The works contemplated by the present project were designed to give a depth of 8 feet at mean lower low water on the bar. As a result of the survey just made, Captain Langfitt arrives at the conclusion that the projected depth of 8 feet on the bar in a fixed channel of sufficient width and of 10 feet across the shoals in the river at and near Florence will accommodate the present and prospective commerce of the river. He also presents alternative plans by which this commerce can be provided for at less cost than that of the existing project.

With a view to securing further data for the information of the Department, this report was referred for consideration and recommendation to the Board of Engineers provided for by section 3 of the act of June 13, 1902. The Board's report of March 26, 1903, is also herewith, to which attention is respectfully invited for a concise résumé of the case.

The Board approves in substance one of the plans proposed by the district officer, the cost of which is slightly less than that of the existing project, and makes definite recommendations as to the character and order of the works to be executed, provided it be the will of Congress to continue this improvement. After a consideration of the subject in relation to the commercial interests involved, and in compliance with that provision of the law which requires that the Board shall submit to the Chief of Engineers recommendations as to the desirability of commencing or continuing any and all improvements upon which reports are required, the Board reports that in its opinion it is not desirable to continue the improvement of the Siuslaw River with a view of obtaining a depth of 8 feet.

I am inclined to concur in the opinion of the Board, but in view of the fact that in a matter of this character the action of the Department is subject to the expressed will of Congress, I recommend that application of the funds available for improving Siuslaw River be withheld for the present, that the question of the advisability of continuing the improvement be fully presented in the forthcoming annual report from this office, and that further action in the matter by the Department be delayed pending further instructions by Congress.

In this connection attention is invited to the accompanying communications from Senators Mitchell and Fulton, and others, from

Oregon, favoring the immediate application of the funds now available.

Very respectfully, your obedient servant,

G. L. GILLESPIE,  
*Brig. Gen., Chief of Engineers,*  
*U. S. Army.*

Hon. ELIHU ROOT,  
*Secretary of War.*

[First indorsement.]

WAR DEPARTMENT,  
*April 16, 1903.*

Approved as within recommended by the Chief of Engineers.

W. SANGER,  
*Assistant Secretary of War.*

---

### W W 13.

#### SURVEY AND ESTIMATE OF COST OF IMPROVEMENT OF TILLAMOOK BAY AND BAR, OREGON.

UNITED STATES ENGINEER OFFICE,  
*Portland, Oreg., April 13, 1903.*

**GENERAL:** In compliance with the intent of the river and harbor act of June 13, 1902, I have the honor to submit the following project, with estimate of cost of securing channels across the bar at the mouth of Tillamook Bay, Oregon, of 15 and 20 feet, respectively. The wording of the act is as follows:

Improving Tillamook Bay and Bar, Oregon: Completing improvement, twenty-seven thousand dollars; and the Secretary of War is authorized and directed to cause to be made a survey and an estimate of the cost of securing channels across said bar of fifteen and twenty feet in depth, respectively.

This survey for the new project was authorized under date of July 17, 1902, and was made in September–October, 1902. A tracing<sup>a</sup> showing its results accompanies this report.

*General description.*—Tillamook Bay, on the Oregon coast, empties into the Pacific Ocean about 50 miles south of the mouth of the Columbia River. The tidal area of the bay is about 13½ square miles, the greater part of which at low tide presents a succession of low sand and mud flats traversed by four principal channels, which, although of fair depth near the entrance, gradually shoal toward the head of the bay.

Four small rivers or streams are tributary to the bay, viz, the Miami, Kilchis, Wilson, and Trask, all of which come from the north and east. The amount of water flowing from these streams, however, is insignificant in comparison with the tidal discharge of the bay. The mean range of tide is 6.3 feet and the average rise of high water above the plane of reference is 7½ feet. The bay connects with the ocean through a gorge 750 feet wide at low tide, with a maximum low-water depth of 60 feet.

---

<sup>a</sup>Not printed.

The southern termination of a moderately high wooded ridge forms the north side of the entrance, a spur of which about 420 feet high, known as Green Hill, covered with fern and brush, lies immediately north of the gorge.

The entrance is bounded on the south by a low lying, sandy peninsula called Kincheloe Point, 4 miles long by from one-tenth to one-half mile wide at high tide. This peninsula is bordered on the sea side by a broad, low-water sand beach, backed by a ridge of sand dunes. It supports a scanty growth of grass and scrub pines.

The approaches to the bay are free from rocks or other hidden dangers. Cape Mears, on which the Government maintains a first-order light-house, lies about 5 miles south of the entrance, and the Nehalem River empties into the ocean 8 miles to the north.

At about  $1\frac{1}{2}$  miles from the beach line at the mouth of the bay the ocean depth is from 15 to 16 fathoms. The crest of the ocean bar is situated about three-fourths of a mile from the general shore line at the entrance, and it is composed of fine shifting gray sand. There is generally but one channel across the bar, whose direction seaward may vary from about northwest to southwest, and there is rarely less than 10 feet minimum depth at low water. The present information does not show any marked excess of movement of sand in either direction up or down the coast. There is a littoral current of varying force along the beach reaching a velocity of 2 miles per hour at a maximum. It is controlled entirely by the winds, which blow from the northwest in summer and generally from the southeast to southwest in winter. The tidal currents in the entrance gorge are strong on account of its narrowness and the considerable tidal discharge.

*Surveys.*—The United States Coast Survey chart of 1867 shows that 9 feet could be carried out at lower low water within narrow limits, and in the buoy list of October, 1885, it is stated that there was then only 7 feet of water on the bar, but the next year 16 feet could be carried over it at high tide. The United States Engineer Department has made three surveys of the bar. The first, made in 1891, shows a channel leading out about in a west by south direction, with a least depth at mean lower low water of 11 feet; the second, made in 1897, gives the channel in about the same position, but slightly more to the south, the lower low-water depth being 14 feet; the third survey, made in September–October, 1902, and upon which this project is based, shows the channel in about its most northerly position, leading over the bar about northwest by north, with a least lower low-water depth on the bar of 13 feet. It shows the width between the inside and outside 18-foot curves to be about 3,500 feet, and that between the 12-foot curves to be about 1,800 feet. Previous to the survey of 1902 an automatic tide gauge was operated at Hobsonville, near the mouth, for a period of a year and the plane of lower low tide determined, to which the soundings on the map of the last survey are referred. All of the surveys show a well-defined south spit extending seaward in a westerly direction from Kincheloe Point, with little or no indication of any tendency for the main channel to break through it and assume a southerly direction.

*Plan of improvement.*—It is assumed that the depths mentioned in the act above quoted refer to mean lower low water, the plane of reference generally adopted for the surveys and works of improvement along the coast.

As so many unknown factors enter into the problem of the improvement of a sandy bar harbor, it would appear to be impossible to plan



any work the exact effect of which in the way of permanent depth could be determined mathematically in advance; at the same time, by comparing the capacity of the harbor in question with that of others which have been improved to various depths, a fair idea of what may be expected from certain works of control can be obtained.

The following table gives the tidal area of some of the smaller coast harbors with the average bar depths both before and after improvement, tidal range, etc. :

Harbor.	Tidal area in square miles.	Approximate mean range of tide.	Average least bar depth at mean lower low water before improvement, about—	Average present least bar depth at mean lower low water, about—	Remarks.
		<i>Feet.</i>	<i>Feet.</i>	<i>Feet.</i>	
Coos Bay.....	24	4.2	9 to 12	18 to 20	Improved.
Yaquina Bay.....	5	6.2	7	12	Do.
Siuslaw.....	5½	5.2	6	7	Partially improved.
Coquille.....	8½	4.2	4	6	Do.
Umpqua.....	9½	5.0	11	-----	Not improved.
Tillamook.....	13½	6.8	10	-----	Do.

It would seem that the conditions at Tillamook are relatively favorable to improvement in bar depths, and it is thought that the tidal flow and ebb discharge from Tillamook Bay, if properly directed, and if the movement of the shifting sands into the entrance is checked by suitable works, can be made to maintain a permanent low-water depth of 15 feet, and perhaps as much as 20 feet, at a considerable increase in cost.

The mean tidal discharge throughout the average ebb amounts to 74,000 cubic feet per second. This, of course, is greatly increased at spring tides and the average maximum flow is, of course, much larger. This outflow has excavated the deep hole in the gorge, but as it flows seaward it spreads out over a large arc, and consequently its ability to scour the bar is weakened. The sand agitated by the waves in the immediate vicinity of the entrance is carried into the bay by the flood to be again sluiced out by the powerful ebb currents and redeposited on the bar and spits in the vicinity. The greater part of the moving sand undoubtedly is furnished by the more extensive south spit.

After a careful study of the map and local conditions, the following project for obtaining 15 feet at mean lower low water is submitted. It involves the construction of a north high-tide jetty of rubblestone from the permanent North Head near Green Hill, running seaward in a general westerly direction on a gentle curve concave to the ebb current for a distance of about 5,600 feet from high-water mark, from A to B on the accompanying map. This jetty would act partially to prevent the greater part of the sand movement on the north side, but chiefly as a training wall to gently control the ebb current and to keep it from spreading out to the north, and to confine it between this jetty and the shoal south sand spit.

At the same time it would seem desirable to build a shorter high-tide south jetty extending out from Kincheloe Point 4,400 feet from high-water mark, from D to E, to check the cyclic sand movement into the harbor from the south.

Should these jetties be built, no doubt the enrockment would be beaten down toward their outer ends to mean tide, and even much lower at their seaward extremities.

The distance between the end of the south jetty and the north jetty, as laid down on the map, is about 1,600 feet. The proposed south jetty would skirt the north edge of the spit closely, and prevent too great a widening of the entrance channel and the risk of shoals forming therein. It is thought that this arrangement would result in strengthening and building up of the south spit, which, acting as a submerged jetty, will tend to prevent any tendency for the channel to cut out to the south, and it seems probable that a navigable channel of 15 feet in depth at mean lower low water will be secured, and that the bar will not be advanced seaward to any great extent.

For the 20-foot project, the north jetty should be extended 1,000 feet farther seaward on the same curve to C, and at the same time the south jetty 3,800 feet on a curve to F, so that the ends of the two jetties would be 1,000 feet apart. This width, however, is approximate, and can be varied as may seem desirable at time of construction. The estimates would not be materially altered by moderate changes. These two long jetties will probably extend the bar farther seaward, but it will be in deeper water, and the detrimental sand movement over the spits and into the channel and thence to the bar would be almost entirely checked, and it is hoped that as much as 20 feet at mean lower low water would be secured on the bar.

The method of construction of the jetties is assumed to be the same as that heretofore adopted for the Oregon coast harbors, and consists of a foundation brush mattress on which a mound of rubblestone blocks, weighing up to 10 tons or more each, is deposited from a double-track pile-trestle tramway extended from the shore in advance. In making the estimates the enrockment is figured at 20 feet wide on top with side slopes of 1 on 2 beyond the 6-foot contour. To allow for settlement and scour the depth is taken as 2 feet more than the map shows, and the top of enrockment 1 foot above ordinary high tide. In computing the volume of stone required for the jetties the displacement of the mattresses is neglected, as in their compressed state they add an inconsiderable amount to the volume of the jetty. Timber and brush can be cheaply obtained in the vicinity, but from the most accurate information available it is believed there is no very suitable stone for jetty purposes to be obtained on Tillamook Bay or very near by, and in making the estimates I have put the price at \$1.25 per ton.

To protect the shore from scour along the approach to the north jetty and this part of the tramway from drift, the estimates provide for a brush mattress 2 feet thick and 22 feet wide, to be laid on the channel side and ballasted with about 4 tons of stone per linear foot. It is possible that a part of the approach may not require this protection.

The estimates provide for a foundation brush mattress 3 feet by 22 feet wide, to be laid in the middle along the line of both jetties. Sand-binding grasses should be planted on the south spit, from where the jetty crosses it southward, to gradually cover a wide strip connecting the permanent vegetation in that direction. No separate item for this is placed in the estimates, as the amount for contingencies will cover it.

The General Government has appropriated the total sum of \$105,700 to date for the improvement of Tillamook Bay, most of which has been expended in accordance with the existing project to obtain a channel 9 feet deep from Hobsonville up to Tillamook city at high tide.

*Resources and commercial statistics.*—There are four small towns

tributary to the waters of Tillamook Bay—Hobsonville, Bay City, Garibaldi, and Tillamook city, the chief of which is Tillamook city, with a population of about 1,000 people, located on Hoquarten Slough, about 10 miles from the entrance. There is no railroad communication to the bay, and the locality is isolated and cut off from market by the Coast Range Mountains. The only means of transportation, other than by water, is over rough mountain roads.

A fair-sized sawmill is located at Hobsonville, owned by the Truckee Lumber Company, and this mill ships most of its products by steam schooners to California markets.

A great deal of the country adjacent to Tillamook Bay is still a virgin forest, undeveloped and thinly populated. It contains some of the finest forests of fir, spruce, and hemlock in Oregon, and it is estimated that there are 21 townships tributary to the bay, upon which there are 15,120,000,000 feet B. M. of standing timber. Near the upper end of the bay is a considerable body of good grazing land, and the making of butter and cheese is one of the principal industries. A salmon cannery is located at Garibaldi, which puts up about 10,000 cases annually. A small steamer of 131 tons net makes as regular trips as possible between Tillamook and Astoria on the Columbia River, making the run in about seven hours.

The following are the estimates made for the two projects called for by Congress:

## ESTIMATES.

*For channel carrying 15 feet depth across the bar at mean lower low water.*

## NORTH JETTY.

Cost of land necessary for site.....	\$2,000.00
Wharf and buildings at H .....	8,000.00
Double-track tramway approach, H to A, 4,930 linear feet, at \$5.....	24,650.00
Shore protection of mats and stone from H to A, 4,930 linear feet, at \$6.20.....	30,566.00
Double-track jetty tramway from A to B, 5,600 linear feet, at \$6 .....	33,600.00
Foundation brush mattress from A to B, 18,689 cubic yards, at \$1.20....	16,426.80
Jetty enrockment from A to B, 272,378 tons rubblestone, at \$1.25.....	349,222.50
Engineering, superintendence, and contingencies, 20 per cent .....	92,892.90
Total for north jetty .....	557,858.20

## SOUTH JETTY.

Cost of necessary land for site.....	\$1,500.00
Wharf, buildings, etc., at G .....	10,000.00
Double-track tramway approach from G to D, 2,650 linear feet, at \$5 .....	13,250.00
Double-track jetty tramway from D to E, 4,450 linear feet, at \$6.....	26,700.00
Foundation brush mattress, 10,877 cubic yards, at \$1.20 .....	13,052.40
Enrockment of south jetty, 147,352 tons of rubblestone, at \$1.25 .....	184,190.00
Engineering, superintendence, and contingencies, 20 per cent .....	49,738.48
Total for south jetty .....	298,430.88

## SUMMARY FOR 15-FOOT PROJECT.

North jetty .....	\$557,858.20
South jetty.....	298,430.88
Total cost of north and south jetties.....	855,789.08

## 2244 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

*Channel carrying 20 feet depth across the bar at mean lower low water.*

## NORTH JETTY.

Cost of necessary land for site.....	\$2,000.00
Wharf and buildings at H.....	8,000.00
Double-track tramway approach, H to A, 4,930 linear feet, at \$5.....	24,650.00
Shore protection of mats and stone from H to A, 4,930 linear feet, at \$6.20.....	30,566.00
Double-track tramway from A to C, 6,600 linear feet, at \$6.....	39,600.00
Foundation brush mattress from A to C, 16,133 cubic yards, at \$1.20.....	19,359.60
Jetty enrockment from A to C, 370,044 tons of rubble stone, at \$1.25.....	462,555.00
Engineering, superintendence, and contingencies, 20 per cent.....	117,346.12
Total for north jetty.....	704,076.72

## SOUTH JETTY.

Cost of necessary land for site.....	\$1,500.00
Wharf, buildings, etc., at G.....	10,000.00
Double-track tramway approach from G to D, 2,650 feet, at \$5.....	13,250.00
Double-track jetty tramway from D to F, 8,150 linear feet, at \$6.....	48,900.00
Foundation brush mattress from D to F, 19,921 cubic yards, at \$1.20.....	23,905.20
Enrockment of south jetty from D to F, 397,351 tons, at \$1.25.....	496,688.75
Engineering, superintendence, and contingencies, 20 per cent.....	118,848.79
Total for south jetty.....	718,092.74

## SUMMARY FOR 20-FOOT PROJECT.

North jetty.....	\$704,076.72
South jetty.....	718,092.74

Total cost of north and south jetties..... 1,417,169.46

The above estimates seem high, but owing to the advanced prices of material and labor, the uncertainty of securing good rock in the vicinity, and to the general local conditions the figures are considered as low as they could safely be made.

It might be possible to obtain and maintain a channel of the required depth across Tillamook bar by means of dredging, but owing to the prevalence of the heavy swell at this locality the greater part of the time, and to the fact that no dredging of like character has yet been done along this part of the coast, it was considered safer to base the estimates for improvement on permanent work. Should the dredging work on the bar at the mouth of the Columbia River soon to be undertaken prove successful, and the depths thereby secured be well maintained at a reasonable cost, it is possible that the expense of the improvement of Tillamook bar and its maintenance by dredging might prove to be less than the interest on the cost of the jetties.

Very respectfully, your obedient servant,

W. C. LANGFITT,  
*Captain, Corps of Engineers.*

Brig. Gen. G. L. GILLESPIE,  
*Chief of Engineers, U. S. A.*

(Through the Division Engineer.)

[First indorsement.]

U. S. ENGINEER OFFICE, NORTHERN PACIFIC DIVISION,  
*San Francisco, Cal., May 4, 1903.*

Respectfully forwarded to the Chief of Engineers, U. S. Army.

The jetties, if built, will doubtless produce the depths contemplated, and they can probably be constructed within the limits of the estimates.

From the language in the clause relating to the appropriation for this particular work, an expression of opinion as to the necessity or worthiness of the appropriation does not seem to be required.

W. H. HEUER,  
*Lieut. Col., Corps of Engineers,*  
*Division Engineer.*

[Second indorsement.]

OFFICE CHIEF OF ENGINEERS,  
U. S. ARMY,  
*May 15, 1903.*

Respectfully referred to the Board of Engineers for Rivers and Harbors constituted by Special Orders, No. 24, Headquarters, Corps of Engineers, series of 1902, for consideration and recommendation.

By command of Brigadier General Gillespie:

A. MACKENZIE,  
*Colonel, Corps of Engineers.*

[Third indorsement.]

BOARD OF ENGINEERS FOR RIVERS AND HARBORS,  
*Washington, D. C., August 3, 1903.*

Respectfully returned to the Chief of Engineers, U. S. Army.

The Board of Engineers for Rivers and Harbors has considered the within report of the district officer on a survey of Tillamook Bay, Oregon, made with a view to the preparation of a project, with estimate of cost, for "securing channels across said bar of fifteen and twenty feet in depth, respectively," the indorsement of the division engineer thereon, and other data available.

The district officer submits plans for obtaining the channels contemplated, and estimates that the 15-foot channel can be secured at a cost of \$855,789.08, and the 20-foot channel at a cost of \$1,417,169.46.

It should be noted that providing an increased depth across Tillamook bar will not enable that same depth to be carried to any of the ports on the estuary, since the interior channels shoal rapidly as one ascends.

No work has ever been done by the United States on Tillamook bar, but the channel from Hobsonville to Tillamook City has been under improvement since 1888. The object of the project, as last modified, was to secure a depth of 9 feet at high water up to Tillamook City, or 3 feet at mean low water. This project has been completed, but work of maintenance is in progress. The total amount appropriated to June 30, 1902, was \$105,704.68.

In view of the wording of the act directing the survey, neither the district officer nor the division engineer reported upon the desirability of the contemplated work. This Board, however, is required by law to report on this subject.

According to the Annual Reports of the Chief of Engineers the amount of the commerce of this harbor for a period of thirteen years is as follows:

	Tons.		Tons.
1889 .....	3,571	1896 .....	25,977
1890 .....	27,427	1897 .....	29,405
1891 .....	28,292	1898 .....	35,885
1892 .....	33,220	1899 .....	36,835
1893 .....	18,316	1900 .....	17,640
1895 .....	29,742	1901 .....	21,147

The principal articles of import during the calendar year 1901 were: Coal, 352 tons; grain, feed, and flour, 952 tons; and machinery, 435 tons; and of export dairy produce, 755 tons; fish, 383 tons; lumber, 17,344 tons; and laths, 290 tons. No railroad reaches this bay from the interior. The imports are therefore for local use and consumption. The small volume of imports (2,201 tons) is accounted for by the fact that the country bordering the bay is thinly settled, the entire population of Tillamook County in 1901 being but about 4,000. The trade with the outside world is carried on in vessels which draw, when fully laden, from 9 to 15 feet (Annual Report of Chief of Engineers for 1902, p. 2374). Yet the total volume of exports in 1901 was but 18,946 tons.

The country contiguous to the bay is rich in forest and agricultural resources, and undoubtedly the products of field and forest will increase with time and with the settling up of the country. At the present time, however, the contrast between the commerce present and reasonably prospective and the sum required to provide even the lesser of the two channels referred to in the act is too great to warrant undertaking the work. Tillamook Bay is but 50 miles from the mouth of the Columbia River, too near for a second harbor of general interest. Furthermore, in case any improvements were undertaken at Tillamook, in the absence of a railroad the exports from the bay would necessarily be drawn from but a limited section of country.

The Board is of opinion that it is not desirable at the present time for the United States to undertake the improvement of Tillamook bar to the extent of providing either a 15-foot or a 20-foot channel across it.

For the Board:

CHAS. J. ALLEN,  
*Lieut. Col., Corps of Engineers,*  
*Senior Member Present.*

[Fourth indorsement.]

OFFICE CHIEF OF ENGINEERS,  
U. S. ARMY,  
*September 23, 1903.*

The views of the Board of Engineers for Rivers and Harbors, as expressed in the preceding indorsement, are concurred in.

G. L. GILLESPIE,  
*Brig. Gen., Chief of Engineers,*  
*U. S. Army.*

---

W W 14.

SURVEY OF SNAKE RIVER, IDAHO, FROM MOUTH OF IMNAHA RIVER TO LEWISTON.

UNITED STATES ENGINEER OFFICE,  
*Portland, Oreg., April 22, 1903.*

GENERAL: I have the honor to report as follows on a survey of the Snake River, Idaho, from the mouth of the Imnaha River to Lewiston, made in October, 1902; and also to submit a project for the improvement of that part of the river above Lewiston, both being in accordance with the project for the expenditure of funds appropriated by

river and harbor act of June 13, 1902, for improving upper Columbia and Snake rivers, Oregon and Washington, as well as the application toward said improvement of the unexpended balance to the credit of the improvement of Clearwater River, Idaho, which project was submitted to the Chief of Engineers July 1, 1902, and approved by the Secretary of War July 21, 1903.

The river and harbor act above referred to specified that \$25,000 of the available funds could be applied to the improvement of the Snake River between Lewiston and Pittsburg Landing. Owing to the lack of reliable and definite information as to the obstructions in that part of the river above Lewiston, the project submitted for the expenditure of available funds provided for a survey, and the submission of a separate project for this improvement at a later date.

#### SURVEY.

Mr. F. C. Schubert, assistant engineer, left Portland, Oreg., with a party September 15, 1902, and proceeded to Lewiston, Idaho, and after fitting out there continued up the river by batteaux for 52 miles above the mouth of the Clearwater at Lewiston to the mouth of the Imnaha River, from which place the survey downstream was commenced October 4, 1902.

On account of the wild and unsettled state of the country, and the very difficult navigation of the river above, it was deemed advisable to leave out of consideration at this time any improvement of the Snake River above the mouth of Imnaha River, and consequently the survey was not extended above that point.

The survey party consisted of 12 men all told, including chief of party, transit man, and leveler, using four bateaux. A transit and stadia line was run downstream and the shore lines and topography sketched. A diagonal line of soundings was carried down the river and indicates low-water depths. Low-water level was obtained from a gauge set at Lewiston to correspond with the Oregon Railway and Navigation Company's gauge at that place, which was read daily during the survey, throughout which time the stage of the river was exceptionally low, being from four-tenths foot to eight-tenths foot above zero (extreme low water at Lewiston). To obtain the slope of the river a single line of levels, checked by occasional references to the bench marks of a survey made by the Snake River Valley Railroad Company, was carried from the mouth of the Imnaha River to Lewiston.

The low-water discharge of the Snake River, just above the mouth of the Clearwater, was measured and found to be approximately 11,000 cubic feet per second.

The field work of the survey occupied eighteen working days, after which the party returned to Portland, where the results have been plotted on 13 sheets<sup>a</sup> to a scale of 1:5,000, with an index sheet and a profile of the river, all of which accompany this report.

#### DESCRIPTION.

For a general description of the Snake River attention is invited to report on survey and examination printed in House Document No. 127, Fifty-sixth Congress, second session; and also to a report of an

---

<sup>a</sup>Not printed.

examination of the river between Asotin and Pittsburg Landing printed in House Document No. 75, Fifty-sixth Congress, first session, both by Capt. W. W. Harts, Corps of Engineers.

The part of the Snake River covered by the survey of 1902 flows in a slightly west of north direction, between Idaho on the east and Oregon and Washington on the west, for the most part in a deep canyon, which has been eroded through the basaltic rock of the country. In the 52 miles of river between the mouth of Imnaha River and Lewiston the river varies in width from 100 to 1,000 feet. It is a swiftly flowing stream with a total low-water fall of 233 feet in this distance, an average of about  $4\frac{1}{2}$  feet to the mile. The channel, although of sufficient depth for the purposes of navigation, is obstructed by numerous rapids, sharp rocky points, and boulders.

The river is subject each year to very high rises, varying from 18 to 26 feet, usually commencing in May and lasting until September.

The following detailed description of the river is quoted from Mr. Schubert's report:

The pool above the mouth of the Imnaha River is said to be about 4 miles long. From the mouth of the Imnaha River to  $1\frac{1}{4}$  miles below, the low-water channel is from 200 to 300 feet in width, and passes between steep, rocky slopes, which extend to the water surface on the Idaho side. On the Oregon shore the mountain slopes flatten at their feet, where a bar or bench has formed, so that from high to low water the shore is composed of small boulders.

At a point  $1\frac{1}{4}$  miles below Imnaha the river enters Mountain Sheep Narrows, and in places where boulder and rock points extend beyond the general shore line the river is hardly 100 feet wide, and passes between perpendicular rock walls with massive boulders at their feet.

From Imnaha River to the foot of the narrows, rapids exist in five different places, and a steamer will have difficulty in ascending, especially at the Sheep Creek Rapids.

From the foot of Sheep Creek Rapids to the mouth of the Salmon River the river passes between perpendicular rock walls and is generally 150 feet in width. There is little current in this stretch and the water is deep and without obstructions.

The tops of the mountains in this vicinity are from 1,500 to 2,000 feet in height. The slopes, which are rough and broken, are covered in places with bunch grass and cactus.

The Salmon River enters the Snake at a point  $3\frac{1}{4}$  miles below Imnaha. A gravel bar has formed on the Idaho side at this point directing the current of the Salmon River across that of the Snake.

From the Salmon River to a point 2 miles below, low-water channel is about 300 feet in width and not less than 14 feet deep. The mountain slopes on the Idaho shore extend to the water, while on the Oregon shore an extensive bar of boulders has formed, is about 40 feet above low water, and covered with bunch grass and cactus. Rapids exist in this stretch of 2 miles, and when cleared of a few obstructions will not seriously interfere with navigation.

For the next 8 miles the river flows through a canyon the sides of which are perpendicular rock bluffs; the channel is from 200 to 400 feet in width, and deep, with little current and few obstructions. With the exception of the removal of a few boulders no improvement is required in this stretch.

The mountains are about 1,500 feet high in this vicinity. At a point  $11\frac{1}{4}$  miles below Imnaha the river leaves the canyon above mentioned, and the distance between the foot of the mountain slopes has increased to about one-fourth mile; the river bed has widened, too, and at a point 13 miles below Imnaha River is about 1,000 feet wide and obstructed by extensive gravel islands known as Cochran Islands, which divide the river into two channels. The main channel is on the Idaho side, and is about 200 feet wide, shoal, and the current quite swift. Steamers may need a line at this point in two places.

From the foot of Cochran Islands to  $1\frac{1}{4}$  miles below, the channel is about 500 feet in width, of sufficient depth and not much current. Both shores are gravel and evidences of placer mining exist at a number of places. The gravel bars in the stream in this locality appear to be the result of placer mining.

At 15 miles below Imnaha the river is obstructed by a gravel bar in mid stream which nearly fills the channel, leaving a channel on the Idaho side of about 200



feet wide. A steamer will have difficulty ascending this place, which is known as Congar Rapids, without a line.

About one-half mile below this point the river is obstructed by rocky reefs from left bank, but they are not serious obstructions.

For the next  $2\frac{1}{4}$  miles the channel is from 300 to 500 feet wide, deep, and with one rapid. This is known as Shovel Creek Rapids and a steamer may need a line to ascend them.

The mountain slopes are steep through this stretch, and gravel bars have formed along each shore. The general width of the valley is from 800 to 1,000 feet, and the hills are from 1,000 to 1,500 feet high, with rough broken slopes covered with bunch grass and cactus.

The next three-fourths of a mile includes both the Wild Goose and the Nigger rapids. A steamer will have great difficulty in ascending the former at low stages of water, but at high stages a steamer can cross the head of the slough, on the Idaho side of the river, which is obstructed by a high gravel island in mid-channel, connected with the right bank by a low gravel bar, which is out of water at low water. Nigger Rapids should give no trouble when the channel is cleared of a few bowlders. This place has been the head of navigation until the present time.

From the foot of Nigger Rapids to the head of Grande Ronde Rapids (22 miles below Imnaha), a distance of  $2\frac{1}{4}$  miles, the river passes through a canyon about 500 feet wide. The water is deep and has little or no current.

The river has now reached the Grande Ronde, and extensive gravel bars have formed on both sides of the stream (the Grande Ronde Rapids are caused by these bars), the water is shoal, and at the mouth of the Grande Ronde River, which enters the Snake here (23 miles below Imnaha), the greatest depth of low water is 5 feet and the width of river about 600 feet. A large flat bar has formed at the confluence of the Snake and Grande Ronde rivers, and the surrounding hills are low and covered with bunch grass.

For  $1\frac{1}{4}$  miles below the Grande Ronde River the channel is about 600 feet in width and of sufficient depth for navigation. Captain Lewis Rapids (24 $\frac{1}{4}$  miles below Imnaha) is the next obstruction met with. A gravel bar from right bank has narrowed the channel to about 250 feet in width, causing a quick fall in the slope. The water is very rough and dangerous for small boats. A steamer will have difficulty at low water in ascending, even with a line.

From the foot of Captain Lewis Rapids to the head of Captain John Rapids (28.4 miles below Imnaha River) the river will require but little improvement.

At Captain Lewis Rapids an extensive gravel bar has formed on the right bank, reducing the low water width of the stream to about 350 feet. A line may be required to get over these rapids during low water, but they are drowned out at high water.

From Captain Lewis Rapids to Buffalo Rapids, about  $3\frac{1}{4}$  miles, the river channel will need but little attention.

Buffalo Rapids,  $31\frac{1}{4}$  miles from Imnaha, are caused by a gravel island which divides the river into two channels. The main channel is about 250 feet wide, and at low water is somewhat rough, but gives no trouble at ordinary stages. The wagon road (from Lewiston, Idaho) ends about 1 mile above the place, at a point 31 miles below Imnaha, known as Buffalo Rock. A trail from the end of the wagon road follows the right bank of the Snake to the Grande Ronde River.

From the foot of Buffalo Rapids to the head of Ten Mile Rapids, a distance of 10 miles, the river is about 600 feet in width, and will require very little improvement.

Ten Mile Rapids (42 miles below Imnaha) are caused by gravel islands in mid-stream. The channel is reduced suddenly to 350 feet in width. The rapids are not bad even at low water.

From Ten Mile Rapids to Asotin the channel is wide and of sufficient depth. The valley had widened out considerably and the hills are much lower. Asotin, Asotin County, Wash.,  $45\frac{1}{4}$  miles below Imnaha, has a population of about 600 (census 1900 gives 470), and is situated on a low flat about the level of high water, on the left bank of the Snake. It is the only settlement on the Snake River between Imnaha and Lewiston, Idaho.

From Asotin to Lewiston the river is from 500 to 600 feet in width (at low water) and has no important obstruction, and will require little or no improvement.

2250 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

*List of rapids and prominent points in Snake River from Imnaha River to Lewiston, Idaho.*

Locality.	Distance from Imnaha River.	Elevation of low-water surface.	Fall of water.	Rate of fall per mile.	Length of rapid.	Least depth at low water.	Velocity of current.	Character of bottom.
	Miles.	Feet.	Feet.	Feet.	Mls.	Feet.	Mls.	
Beginning of survey, mouth of Imnaha River.		939.4						
Rapids No. 1—Imnaha Rapids:								
Head	0.08	939.4						Large bowlders.
Foot	.27	934.2	5.2	30	0.17	9	8	
Rapids No. 2—Upper Deer Creek:								
Head	.55	930.4						Small bowlders.
Foot	.65	928.4	1.6	18	.10	20	8	
Rapids No. 3—Lower Deer Creek:								
Head	.80	925.8						Small bowlders and gravel.
Foot	1.08	923.07	2.1	8	.23	11	4	
Rapids No. 4—Bear Creek Rapids:								
Head	1.18	923.4						Rock and bowlders.
Foot	1.38	920.2	3.2	16	.20	23	7	
Rapids No. 5—Sheep Creek Rapids:								
Head	1.8	917						Solid rock and bowlders.
Foot	2.2	912.6	4.4	11	.04	11	7	
Riffle No. 1:								
Head	2.84	910.7						Do.
Foot	2.91	910.2		7.71	.07	14	4	
Rapids No. 6—Salmon River Rapids:								
Head	3.28	909.6						Do.
Foot	3.45	908.7	1.1	5.8	.19	14	4	
Rapids No. 7—Salmon River Falls:								
Head	3.90	908.1						Large bowlders.
Foot	3.94	906.1	2	50	.04	29	7	
Between falls and riffles			5.5	29	.19	14	6	Water fairly smooth.
Riffle No. 2:								
Head	4.13	900.6						Bowlders.
Foot	4.21	899.8	.8	9.62	.06	15	5	
Riffle No. 3:								
Head	6.65	891.8						Solid rock and bowlders.
Foot	6.73	890.4	1.4	18	.06	14	5	
Riffle No. 4:								
Head	8.12	889.6						Bowlders.
Foot	8.30	887.3	2.3	12.8	.18	27	4	
Riffle No. 5:								
Head	8.54	887.3						Solid rock and bowlders.
Foot	8.64	885.3	2	20	.10	14	4	
Riffle No. 6:								
Head	11.90	883.5						Gravel and small bowlders.
Foot	12.24	880.5	3	3.22	.24	5	4	
Rapids No. 8:								
Head	12.50	880.1						Large bowlders and gravel.
Foot	12.74	874.2	5.9	24.58	.24	6	7	
Rapids No. 9:								
Head	13.02	871.6						Bowlders and gravel.
Foot	13.30	867.8	3.8	13.57	.23	6	6	
Riffle No. 7:								
Head	14.18	864						Coarse gravel.
Foot	14.59	861.3	2.7	5.37	.43	6	4	
Rapids No. 10—Congar Rapids:								
Head	14.97	861.2						Large bowlders, solid rock, and gravel.
Foot	15.19	855.3	5.9	23.81	.23	7	8	
Rapids No. 11—China Gardens:								
Head	15.47	852.5						Solid rock with bowlders.
Foot	15.74	847.9	4.6	17.04	.27	8	5	
Rapids No. 12—Shovel Creek head.	17.23	843.6	7.3	29.2	.25	6	6	Solid rock and bowlders.
Rapids No. 13—Wild Goose Rapids:								
Head	18.53	835.7						Large bowlders.
Foot	18.66	830.5	6.2	47.7	.13	9	8	
Rapids No. 14—Nigger Rapids:								
Head	18.96	823.9						Solid rock bowlders and gravel.
Foot	19.32	824.2	4.7	13.3	.34	4	5	
Rapids No. 15—Grande Ronde:								
Head	23	822						Rock reef and gravel.
Foot	22.27	816.2	5.8	21.5	.27	5	5	
Riffle No. 8:								
Head	22.67	813.8						Coarse gravel.
Foot	23.13	806.6	5.3	10	.51	4	4	

*List of rapids and prominent points in Snake River from Imnaha River to Lewiston, Idaho—Continued.*

Locality.	Distance from Imnaha River.	Elevation of low-water surface.	Fall of water.	Rate of fall per mile.	Length of rapid.	Least depth at low water.	Velocity of current.	Character of bottom.
Rapids No. 16—Captain Lewis Rapids:								
Head .....	Miles. 24.64	Feet. 805.1						Large bowlders.
Foot .....	24.85	797.5	7.6	86.2	.21	6	7	
Rifle No. 9:								
Head .....	25.09	795.4						Solid rock and gravel.
Foot .....	25.41	792.2	3.2	10	.63	7	8	
Rifle No. 10:								
Head .....	26.68	791.1						Coarse gravel and bowlders.
Foot .....	26.77	788.4	2.7	19.8	.14	19	4	
Rifle No. 11:								
Head .....	26.96	788.3						Small bowlders.
Foot .....	27.10	787.5	.8	4.7	.17	11	8	
Rapids No. 17—Captain Johns:								
Head .....	28.24	786.9						Small bowlders and gravel.
Foot .....	28.38	783.1	3.8	27.1	.14	9	6	
Rifle No. 12:								
Head .....	30.51	780.4						Coarse gravel.
Foot .....	30.87	776.9	3.5	9.7	.66	8	4	
Rapids No. 18—Buffalo Rapids:								
Head .....	31.72	773.6						Coarse gravel.
Foot .....	31.95	769	4.6	20	.23	4	7	
Rifle No. 13:								
Head .....	34.6	761.8						Coarse gravel.
Foot .....	34.85	758	3.8	15.2	.25	8	4	
Rapids No. 19—Ten-Mile Rapids:								
Head .....	41.87	745.1						Coarse gravel and small bowlders.
Foot .....	42.44	740.3	4.8	8.1	.57	4	6	
Asotin, Wash.	45.5	728						
Rapids No. 20—Slaughter House Rapids:								
Head .....	50	715.5						Coarse gravel and small bowlders.
Foot .....	50.34	710.8	4.7	13.8	.34	5	6	
Rapids No. 21—Coxs Rapids:	51	710.2						Solid rock and bowlders.
No rapids at low water.								
Lewiston, Idaho	51.5	709.6						
Rapids No. 22—Lewiston Rapids:								
Head .....	51.53	709.6	4.8					Coarse gravel and small bowlders.
Foot .....	52.04	705.3		8.4	.51	6	7	
Mouth of Clearwater River	52.1	703.5						

Length of river surveyed, 52.1 miles.

NOTE.—Elevations refer to mean low tide at Astoria, Oreg., as given by the Oregon Railroad and Navigation Company's levels.

Water surface refers to extreme low water.

There is little or no commerce on the Snake River above the Grande Ronde River. Such supplies, etc., as are required by the mining camps above Wild Goose Rapids are brought in by pack animals or up the river in small boats. The Eureka Mining, Smelting and Power Company is developing some promising copper mines on the Imnaha River, and has nearly completed at Lewiston a very light draft heavily powered steamboat to be used on the upper river in connection with its mines.

Between Lewiston and Wild Goose Rapids, 32 miles up the river, the country has considerable settlement, and some wheat is raised on the plateau above the river.

The Oregon Railway and Navigation Company's stern-wheel steamboats navigate the river as far as Wild Goose Rapids when the river is at a medium stage and bring down wheat from a number of shipping points mostly below the Grande Ronde River. A granite quarry, 2 miles above Wild Goose Rapids, has been worked, and some lime

made from the limestone ledges near Grande Ronde. There is no timber on the Snake River between Imnaha and Lewiston. Many mining prospects exist along or near the river between Lewiston and Imnaha some of which may develop into profitable mines. The country is new and sparsely settled, but is capable of considerable growth in population and resources if regular transportation was established on the river.

Between Lewiston and Imnaha the difficulties in the way of navigation arise, not from insufficient depth, but from the excessive fall with its consequent rapids and swift currents, and from many dangerous rocky points and bowlders, especially in crooked parts of the channel, some of which interfere with navigation at low water and others at higher stages. In any case it is thought that steamboats will find it necessary to line up over some of the rapids, but by blasting out the most troublesome bowlders and rocky reefs and points at various places as indicated in the following table, it is thought that powerful light-draft steamboats can use the river at average stages as far up as Douglas Rapids, 4 miles above the mouth of the Imnaha.

The total estimated cost of doing this work, including some gravel dredging, is \$33,690.

*Estimated cost of improvement at various points between the mouth of the Imnaha River and Lewiston, Idaho.*

Improving Imnaha Rapids just below the mouth of Imnaha River by the removal of bowlders from the channel, and the point of a rocky reef extending from the left bank:		
Removal of 70 cubic yards of rock bowlders, at \$5 .....	\$350	
Removal of 80 cubic yards of rock reef, at \$3 .....	240	
		\$590
The clearing of the channel at upper Creek Rapids of a number of rock bowlders and rock points close to shore, 30 cubic yards of bowlders at \$5 .....		150
The removal of a number of rock points close to the Oregon shore at lower Deer Creek Rapids, 350 cubic yards of solid rock, at \$3 .....		1,050
The clearing of the channel of rock bowlders at Bear Creek Rapids, 800 cubic yards of large bowlders, at \$2 .....		1,600
The removal of small rock bowlders extending from both banks and widening the channel by blasting off rocky points at Sheep Creek Rapids and Narrows:		
700 cubic yards of solid rock bowlders, at \$2 .....	\$1,400	
3,300 cubic yards solid rock bowlders, at \$1.50 .....	4,950	
		6,350
Improving Riffle No. 1, near mouth of Salmon River, by removal of point of bowlder extending from left bank, 25 cubic yards of bowlders, at \$3 ..		75
The removal of solid rock reefs at Salmon River Rapids, 300 cubic yards of rock reef, at \$3 .....		900
Improving Salmon River falls by blasting some rocky points showing about 2 feet above low water and the removal of some small gravel from bar:		
30 cubic yards solid rock reefs, at \$5 .....	\$150	
200 cubic yards gravel, at \$1 .....	200	
		350
Riffle No. 2, requiring the removal of bowlders from banks, 360 cubic yards solid rock reefs and bowlders, at \$3 .....		1,080
The removal of a small amount of solid rock in mid stream at Narrows, 4½ miles below Imnaha, 20 cubic yards solid rock, at \$7 .....		140
Riffle No. 3, the removal of a small rock and bowlder point on right bank, 30 cubic yards bowlders, at \$3 .....		90
The removal of 25 cubic yards of bowlders at Riffle No. 4, 8½ miles from Imnaha, at \$3 .....		75
The removal of solid rock in stream 10½ miles below Imnaha, 200 cubic yards solid rock, at \$3 .....		600

The blasting out of rocks in mid-channel at Rapids No. 8, Upper Cochran's, 12½ miles from Imnaha, 100 cubic yards bowlders in stream, at \$5 .....	\$500
The removal of small bowlders from right bank and also from the west channel at Rapids No. 9 (Lower Cochran Islands), 170 cubic yards small bowlders, at \$3 .....	510
Improving Cougar Rapids No. 10 by widening the channel by the removal of gravel at the head and a small rock point in mid stream just below Imnaha:	
30 cubic yards solid rock, at \$3 .....	\$90
1,000 cubic yards gravel, at 60 cents .....	600
	690
Improving Rapids No. 11 (China Gardens) by the blasting out of several rocky points extending into the stream from the left bank, 150 cubic yards solid rock in stream, at \$5 .....	750
Improvement of Rapids No. 12 (Shovel Creek Rapids), clearing the channel of bowlders, 150 cubic yards bowlders in stream, at \$5 .....	750
Improvement of Wild Goose Rapids (No. 13), which is a serious obstruction, clearing the channel, slough, and banks of bowlders, 3,000 cubic yards of bowlders to be blasted and removed, at \$2.50 .....	7,500
Removing bowlders and reefs at No. 14 (Nigger Head Rapids), 19 miles from Imnaha, 200 cubic yards bowlders and rock reefs, at \$5 .....	1,000
Improvement of Grande Ronde Rapids, 22 miles below Imnaha, by removal outer end of rock reef extending from left bank, 75 cubic yards of solid rock, at \$5 .....	375
Clearing channel at Captain Lewis Rapids (No. 16) by blasting out submerged bowlders in channel, 50 cubic yards submerged rock, at \$10 .....	500
Rifle No. 9, removal of solid rock reefs, 25 cubic yards of solid rock in stream, at \$4 .....	100
The removal of two rocky reef points, 26½ miles below Imnaha, 15 cubic yards solid rock, at \$5 .....	75
Rifle No. 10, the removal of 10 cubic yards of bowlders, at \$5 .....	50
Improvement of Captain John Rapids, 28.2 miles below Imnaha, by removing some small bowlders at head of rapids at low-water channel, and a gravel point on the right of channel at head of rapids:	
50 cubic yards of small bowlders, at \$2 .....	\$100
200 cubic yards of gravel, at \$1 .....	200
	300
Rifle No. 12, the removal of 1,000 cubic yards of gravel by dredging, at 60 cents .....	600
The removal of 15 cubic yards of rocky reefs near Cayuse Creek, 34 miles below Imnaha, at \$5 .....	75
Rifle No. 13, the dredging of about 1,500 cubic yards of gravel to aid navigation at low water, at 60 cents .....	900
Ten-Mile Rapids (No. 18), 42 miles below Imnaha, the removal of about 20 cubic yards of bowlders in bend near foot of rapids, at \$8 .....	160
The blasting out of about 15 cubic yards solid rock below Asotin, at \$6 .....	90
The improvement of high-water navigation at Cox's Rapids, 51 miles below Imnaha, by the removal of 10 cubic yards of solid rock reefs, at \$10 .....	100
	28,075
Contingencies, etc., 20 per cent .....	5,615
Total .....	33,690

Based on the results of the survey, the following project for the expenditure of the \$25,000 appropriated by act of June 13, 1902, for improvement of Snake River between Lewiston and Pittsburg Landing is submitted:

Expended for survey authorized by letter from Chief of Engineers, dated July 26, 1902, approving project submitted July 1, 1902 .....	\$2,500
Allotted for part payment of dredge by letter of July 26, above mentioned .....	12,500
Total already allotted or expended .....	15,000
Balance available for future work .....	10,000

2254 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

It is proposed to extend this sum approximately as follows:

Removal of rocks, dredging, etc., as may be of most benefit to navigation between Lewiston and Imnaha River.....	\$8,500
Office expenses, contingencies, etc .....	1,500
Total.....	10,000

It is proposed to do the work by hired labor and purchase of necessary materials according to existing regulations, this being the manner most economical and advantageous to the Government.

By second indorsement of letter to Chief of Engineers, February 11, 1903, the expenditure of \$5,000 for removal of rocks, boulders, etc., was authorized. This expenditure was contingent on the completion of the construction of a small steamboat by private parties in time for low-water work this season. It seems now that this steamer will not be available in time. The above project, therefore, covers all the available funds.

In view of the limited funds available for active work it is proposed to defer survey and preparations of project for the portion of the river from Imnaha to Pittsburg Landing until further appropriation is made.

The part of the river covered by the project here submitted is the most important.

The construction of the self-propelling boat is essential in any case, and the dredging machinery adds to her usefulness at small proportionate cost.

Very respectfully, your obedient servant,

W. C. LANGFITT,

*Captain, Corps of Engineers.*

Brig. Gen. G. L. GILLESPIE,

*Chief of Engineers, U. S. A.*

(Through the Division Engineer.)

[First indorsement.]

U. S. ENGINEER OFFICE, NORTHERN PACIFIC DIVISION,  
*San Francisco, Cal., May 1, 1903.*

Respectfully forwarded to the Chief of Engineers, U. S. Army, recommending approval of the project.

W. H. HEUER,

*Lieut. Col., Corps of Engineers,  
Division Engineer.*

[Second indorsement.]

OFFICE CHIEF OF ENGINEERS, U. S. ARMY,  
*May 16, 1903.*

Respectfully submitted to the Secretary of War.

The river and harbor act of June 13, 1902, appropriated \$40,250 for improvement and maintenance of upper Columbia and Snake rivers, Oregon and Washington, in addition to making available for the work a balance remaining from appropriations previously made for Clearwater River, Idaho. Of the amounts thus made available the sum of \$25,000, or so much thereof as might be necessary, was to be applied to work on Snake River between Lewiston and Pittsburg Landing.

The improvement proposed for this section of the river is new work, and there was no existing plan for application of the funds provided.

The general project approved by the Secretary of War July 21, 1902,

made allotment for a survey of this section, a separate project for its improvement to be submitted later.

The survey has now been made and the local engineer officer submits the within project for expenditure of the funds applicable to the work. Approval by the Secretary of War of the general features of this project is recommended.

\* \* \* \* \*

G. L. GILLESPIE,  
*Brig. Gen., Chief of Engineers,*  
*U. S. Army.*

[Third indorsement.]

WAR DEPARTMENT,  
*May 29, 1903.*

Approved as recommended by the Chief of Engineers.

WM. CARY SANGER,  
*Assistant Secretary of War.*





## APPENDIX X X.

---

### IMPROVEMENT OF WILLAMETTE RIVER, AND OF COLUMBIA RIVER BELOW THE MOUTH OF THE WILLAMETTE, AND THEIR TRIBU- TARIES, OREGON AND WASHINGTON.

---

REPORT OF MAJ. W. C. LANGFITT, CORPS OF ENGINEERS, OFFI-  
CER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1903,  
WITH OTHER DOCUMENTS RELATING TO THE WORKS.

#### IMPROVEMENTS.

- |  |  |
|--|--|
| 1. Willamette River above Portland,<br>Yamhill and Long Tom rivers,<br>Oregon. | 5. Mouth of Columbia River, Oregon<br>and Washington.          |
| 2. Operating and care of lock and dam<br>in Yamhill River, Oregon.             | 6. Clatskanie River, Oregon.                                   |
| 3. Columbia and lower Willamette riv-<br>ers, below Portland, Oregon.          | 7. Cowlitz and Lewis Rivers, Wash-<br>ington.                  |
| 4. Columbia River below Tongue Point,<br>Oregon.                               | 8. Gauging waters of Columbia River,<br>Oregon and Washington. |
- 

ENGINEER OFFICE, UNITED STATES ARMY,  
*Portland, Oreg., July 15, 1903.*

GENERAL: I have the honor to transmit herewith annual report  
\* \* \* for the fiscal year ending June 30, 1903, for works of river  
and harbor improvement in my charge.

Very respectfully, your obedient servant,

W. C. LANGFITT,  
*Major, Corps of Engineers.*

Brig. Gen. G. L. GILLESPIE,  
*Chief of Engineers, U. S. A.*

---

#### X X I.

### IMPROVEMENT OF WILLAMETTE RIVER ABOVE PORTLAND AND YAMHILL RIVER, INCLUDING THE MAINTENANCE OF LONG TOM RIVER, OREGON.

#### OPERATIONS DURING FISCAL YEAR 1903.

The appropriation, by act of June 13, 1902, of \$68,000 for this  
improvement was not sufficient to provide for the work of construct-  
ing a revetment near Independence, to keeping the snag boat in com-  
mission throughout the entire year, and repairing and constructing  
controlling works.

The work done by the snag boat and crew consisted of making repairs to the different dams and dikes previously constructed at points where navigation had been impeded. On these works the most extensive repairs were at the Corvallis revetment. A few new dams were also constructed, the principal ones of which were at Candiani bar, Five Islands, and at the head of Lamberts Slough. The work at Independence was not commenced until May, 1903, owing to the difficulty in securing suitable rock at an advantageous price. A contract was made for furnishing this rock during the high-water season and delivery was completed in the spring, and the work of constructing the revetment at once begun.

The following is a summary of the work performed by the snag boat and plant during the seven months while in commission on the upper Willamette River:

Snags removed by boat and crew .....	1,001
Snags removed by blasting .....	328
Snags, logs, and trees cut from banks .....	687
<b>Total snags removed .....</b>	<b>2,026</b>

Hardpan blasted from channel .....	cubic yards..	60
Powder used .....	pounds .....	4,855
Miles run by steamer .....		1,469
Wood consumed .....	cords .....	349

The average cost of operating the snag boat during the seven months in commission, including cost of powder and general repairs, was about \$1,500 per month.

During May and June the Port of Portland Commission has operated its 20-inch Bowers dredge in Portland Harbor above the Madison Street Bridge in deepening the ship channel to the mills on the east side of the river. The Commission reports 92,458 cubic yards excavated, at a cost of about 8 cents per cubic yard.

The following is a tabular statement of the dams and revetments constructed and repaired on the upper Willamette River during the fiscal year 1903, giving location, length, quantities of material and labor, and total cost:

	Ash Island Dam No. 1 (repaired).	Ash Island Spur Dam No. 2 (re- paired).	Candiani Dam No. 1 (repaired and extended).	Candiani Dam No. 2 (new).	Weston Dam (re- paired).	Coffee Chute Dam No. 1 (repaired).	Coffee Chute Dam No. 2 (new).	Coffee Chute Dam No. 3 (new).	Five Islands Dam No. 1 (new).
Length .....	400	70	620	698	70	360	294	418	1,397
Piles .....			1,248	2,268			816		3,436
Brush .....	75	25	197	285	15	120	150	40	380
Gravel .....	200		620	850		320	530		1,100
Rock .....									
Iron .....			140	180			120		650
Bale rope .....	120	40	410	600	25	320	275	70	410
Lumber .....				800			1,125	6,500	18,275
Wire rope .....									
Powder .....									
Labor .....	\$130	\$30	\$493.50	\$643	\$33	\$180	\$276	\$30	\$1,284

	Five Islands Dam No. 3 (new).	Eldridge (tem- porary).	Allisons (tempo- rary).	Shore protection head Lambert's slough (new).	Corvallis revet- ment (repaired).	Total.	Cost per unit.	Total cost.
Length.....feet.....	400	878	280	225	1,590	7,180		
Piles.....linear feet.....	842					18,538	<sup>a</sup> \$0.00 $\frac{1}{2}$	\$17.08
Brush.....cords.....	65			200	808	5,094	<sup>a</sup> .10	208.76
Gravel.....sacks.....	200					5,880	<sup>b</sup> .07	239.00
Rock.....				100	680	5,850		
Iron.....pounds.....	70					780	2.00	1,520.00
Bale rope.....do.....	110			865	680	1,840	.03 $\frac{1}{2}$	64.40
Lumber.....feet B. M.....	8,000					8,275	.14	458.50
Wire rope.....linear feet.....					400	24,700	10.00	247.00
Powder.....					100	400	.12 $\frac{1}{2}$	50.00
Labor.....	\$177	\$180	\$80	\$335	\$2,172.25	\$6,793.75	.12 $\frac{1}{2}$	12.50
Total.....								9,875.09

<sup>a</sup> Stumpage.<sup>b</sup> Cost of sack.

Cost per foot of work (not including temporary dams), \$1.45.

An index map of the upper Willamette and Yamhill rivers, showing the location of the points under improvement, is herewith.

The only work done on the Yamhill River consisted in scraping a gravel bar at the mouth prior to the period of extreme low water in September and in removing from the channel between the mouth and McMinnville such snags and trees as were brought down by the winter freshets.

The river and harbor act of June 13, 1902, provided for the construction of a dredge for use on this improvement. The bids for the dredge were advertised and the contract has been awarded to the Featherstone Foundry and Machine Company, of Chicago, Ill. At the close of the fiscal year the specifications covering this contract had not been fully accepted and as yet the contract has not been made.

For this work it is estimated that \$15,000 will be required for repairs and extensions to the existing works and for the construction of such new works as may be necessary to maintain the dredged channels; \$10,000 will be required to complete the revetment now under construction at Independence; \$5,000 for repairs and extensions at Corvallis revetment; \$40,000 for the operation of the snag boat and dredge, and \$20,000 will be required for the construction of a new hull and house for the snag boat. The total, \$90,000, as given in the money statement as the amount that can be profitably expended to June 30, 1905, is considered very conservative and should be appropriated.

This work has been in the efficient charge of Mr. David B. Ogden, assistant engineer.

For list of steamers plying these waters, see report for improving Columbia and Lower Willamette rivers below Portland, Oreg.

## 2260 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

*Money statement.*

July 1, 1902, balance unexpended.....	\$68,181.80
June 30, 1903, amount expended during fiscal year.....	82,417.77
July 1, 1903, balance unexpended.....	85,714.03
July 1, 1903, outstanding liabilities.....	22.00
July 1, 1903, balance available.....	85,692.03
Amount that can be profitably expended in fiscal year ending June 30, 1905, for maintenance of improvement, in addition to the balance unexpended July 1, 1903.....	
Submitted in compliance with requirements of sundry civil act of June 4, 1897, and of section 7 of the river and harbor act of 1899.	90,000.00

## APPROPRIATIONS.

Act of—		Act of—	
March 3, 1871.....	\$16,000	August 18, 1894 (of which	
March 3, 1873.....	3,000	\$2,000 was allotted to	
June 23, 1874.....	7,500	Yamhill River.....	\$23,000
March 3, 1875.....	25,000	June 3, 1896 (Willamette	
August 14, 1876.....	20,000	and Yamhill rivers).....	40,000
June 18, 1878.....	20,000	June 4, 1897 (Willamette	
March 3, 1879.....	12,000	and Yamhill rivers).....	160,000
June 14, 1880.....	12,000	Allotted from emergency	
March 3, 1881.....	15,000	act June 6, 1900.....	5,000
August 2, 1882.....	5,000	June 18, 1902.....	68,000
July 5, 1884.....	10,000	Total.....	521,500
August 5, 1886.....	10,000		
August 11, 1888.....	29,000		
September 19, 1890.....	11,000		
July 13, 1892 (of which \$3,000			
was allotted to Yamhill			
River).....	30,000		

NOTE.—By river and harbor act of March 3, 1899, \$3,000 was transferred to and expended on improvement of Long Tom River, Oregon.

## CONTRACTS IN FORCE.

Emergency contract with B. C. Miles, Newberg, Oreg., under date of January 2, 1903, provided for furnishing 2,500 cubic yards of rock (more or less) delivered on bank of Willamette River, near Independence, Oreg., at \$2.25 per cubic yard. Delivery was commenced within ten days from date of contract and completed in the early spring of same year, as required by specifications.

The above was the only contract in force under this appropriation.

## COMMERCIAL STATISTICS.

The canal and locks at Oregon City, overcoming the falls of the Willamette River, are owned and operated by the Portland General Electric Company, and the following is a statement for the year ending December 31, 1902, of the traffic passing through them:

Grain.....	tons...	3,475
Flour and mill stuff.....	do.....	3,800
Coal.....	do.....	177
Wool.....	do.....	301
General merchandise.....	do.....	14,428
Potatoes.....	do.....	3,653
Hops.....	do.....	758

TANGEN

OREGON CITY  
(18)

CLACKAMAS

SELY  
(872)

P O



Paper stock.....	tons..	910
Paper.....	do...	31,959
Lumber.....	feet B. M..	2,080,594
Logs.....	do.....	8,652,501
Wood.....	cords..	8,898
Passengers.....	number..	19,522
Cattle and horses.....	do.....	907
Sheep and hogs.....	do.....	280
Pulp.....	tons..	2,754
Piles.....	linear feet..	81,000

The following statement of traffic on the Willamette River above Portland has been compiled from reports of the various steamers and transportation companies doing business on this part of the river during the year ending December 31, 1902:

	Tons.
Wheat.....	9,396
Other cereals.....	5,658
Flour.....	7,427
Lumber (2,119,868 feet B. M.).....	2,756
Piles (60,578 linear feet).....	1,211
Logs (82,428,000 feet B. M.).....	64,856
Cattle and horses (number, 1,079).....	481
Sheep and hogs (number, 1,529).....	114
Coal.....	227
Wool.....	288
Merchandise.....	65,612
Hay.....	1,165
Potatoes.....	2,841
Hops.....	571
Wood (18,861 cords).....	28,291
Sand and gravel.....	1,388
<b>Total.....</b>	<b>192,227</b>
<b>Passengers carried.....</b>	<b>95,221</b>

## X X 2.

### OPERATING AND CARE OF LOCK AND DAM IN YAMHILL RIVER, OREGON.

The lock was closed to navigation because of high water on November 14, 1902, and during the following winter months until March 6 was closed to traffic seventy-nine days and open thirty-three days. Since March 6 the lock has been continuously available for navigation. The highest water of the year occurred January 27 and registered 21 feet above the top of the lock walls. This extreme high water caused no damage to the adjacent protecting banks and slopes and the work suffered no injury therefrom.

It is believed that the repairs to the slopes and revetment made from allotment for the fiscal year 1902 will insure the future protection and stability of the work.

The repairs for which allotments were made during fiscal year 1902 were completed in September, 1902, and consisted of some 2,000 surface feet of stone paving cemented together with a thin grout of sand and Portland cement.

During the last half of August, when the river had reached its low-water stage, the upper pool was drained and the face and foundation of the dam at its upper side was examined. Some minor repairs were made to the timbering to prevent leakage, and additional stone was

## 2262 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

placed along the face of the dam. During May and June the grounds and upper slopes on the east side of the lock were graded and sown to grass, and the lock grounds are now practically in a finished condition.

*Detailed summary of expenditures for operating and care of lock and dam in Yamhill River, Oregon, during fiscal year ending June 30, 1903.*

Month.	Operating and care.		Repairs.		Engineering, office expenses, and contingencies.	Total.
	Labor.	Materials.	Labor.	Materials.		
1902.						
July .....	\$110.00	\$254.28	\$584.00		\$7.14	\$955.42
August .....	110.00		183.25	\$285.00	19.00	597.25
September .....	110.00	69.52	264.28		20.15	463.93
October .....	110.00	6.90	255.70		6.90	379.50
November .....	82.03	2.15	100.00			184.18
December .....	81.00	26.25				107.25
1903.						
January .....	91.25					91.25
February .....	70.50					70.50
March .....	68.00				175.00	243.00
April .....	66.00	108.69			4.35	179.04
May .....	162.00	215.69				377.69
June .....	243.75	23.30			151.27	418.32
Total .....	1,304.53	706.78	1,887.21	285.00	388.81	4,067.33

*Summary of expenditures made in operating and caring for lock and dam in Yamhill River, Oregon, during fiscal year ending June 30, 1903, submitted in compliance with river and harbor act of July 5, 1884.*

Items of estimate.	Amount expended.
Operating and general care of lock .....	\$2,011.31
Repairs .....	1,672.21
Engineering, contingencies, and office expenses .....	383.81
<b>Total .....</b>	<b>4,067.33</b>

## COMMERCIAL STATISTICS.

*Statement showing traffic through lock and dam in Yamhill River, Oregon, during fiscal year ending June 30, 1903.*

Date.	Lock open.	Lock closed.	Number lockages.	Time operating.	Registered tonnage.	Freight carried.	Passengers carried.
<b>1902.</b>							
July .....	<i>Days.</i> 31	<i>Days.</i> -----	83	<i>h. m.</i> 15 10	4,652	<i>Tons.</i> 609	<i>Number.</i> 231
August .....	15	<i>a</i> 16	17	5 49	2,484	167	44
September .....	27	<i>a</i> 8	5	4 28	-----	<i>c</i> 225	-----
October .....	31	-----	-----	-----	-----	-----	-----
November .....	13	<i>b</i> 17	7	4 00	1,816	190	2
December .....	2	<i>b</i> 29	2	23	658	16	2
<b>1903.</b>							
January .....	13	<i>b</i> 18	-----	-----	-----	-----	-----
February .....	18	<i>b</i> 10	8	1 04	658	55	-----
March .....	26	<i>b</i> 5	4	4 15	-----	<i>c</i> 127	-----
April .....	30	-----	4	3 45	-----	<i>c</i> 206	-----
May .....	31	-----	2	3 30	-----	-----	4
June .....	30	-----	6	5 27	-----	<i>c</i> 150	1
<b>Total .....</b>	<b>237</b>	<b>98</b>	<b>83</b>	<b>44 49</b>	<b>10,446</b>	<b>1,747</b>	<b>234</b>

*a* Lock closed to repair dam.

*b* Lock closed on account of high water.

*c* Logs.



The comparatively small number of lockages during the months when the lock was in operation was due to the withdrawal of the Oregon City Transportation Company's boat which formerly made regular trips to McMinnville. It is claimed by this company that the uncertainty of reaching McMinnville during the winter months because of a frequently closed lock makes it impossible to build up a paying trade in competition with railroad rates, and therefore their boat can be used to a more profitable advantage on the Willamette River.

A report relative to a survey and estimate of cost of a project which has in view the prolonging of the period of navigation on the Yamhill River has been submitted in accordance with the provisions of the last river and harbor act, but has not yet been printed.

The relative location of the Yamhill River and the lock and dam is shown on the map accompanying the report for improving Willamette and Yamhill rivers.

#### *Money statement.*

July 1, 1902 balance unexpended.....	\$1,367.33
Allotted July 12, 1902.....	2,700.00
June 30, 1903, amount expended during fiscal year.....	4,067.33

#### ALLOTMENTS.

September 19, 1900.....	\$1,460
January 18, 1901.....	1,500
May 24, 1901.....	23,200
July 12, 1902.....	2,700
Total.....	28,860

### X X 3.

#### IMPROVEMENT OF COLUMBIA AND LOWER WILLAMETTE RIVERS BELOW PORTLAND, OREGON.

##### OPERATIONS DURING THE FISCAL YEAR 1903.

Dredging for the improvement of the Columbia and lower Willamette rivers below Portland, Oreg., has been the only work done during the fiscal year, as the funds appropriated by act of June 13, 1902, were insufficient to allow of any new works being constructed and new dredge being built.

Operations have been carried on by the U. S. dredge *W. S. Ladd* and by the 30-inch suction dredge of the port of Portland under contract. This contract was made for hire of either their 20-inch or 30-inch dredge, and after a satisfactory trial of the latter it was decided that her employment would prove the most economical and advantageous. After approval of the contract she worked continuously from January 8, 1903, to the end of the fiscal year, removing 993,389 cubic yards of material from different shoals in the channel. The cost of hire of this dredge, including operating expenses, wages, subsistence, and repairs, at the contract price of \$235 per day, amounted to \$29,888.14, making the cost per cubic yard 3.35 cents. The cost of inspection, amounting to \$1,125, is not included in the cost of hire.

The appended table shows the locality of dredging by the 30-inch dredge, time, depth of cut, amount of material removed, etc.:

Locality.	Periods at work.	Days working.	Hours pumping.	Average depth.		Width of cut.	Amount of material dredged.	Length of cut.	Time removing snags, etc.
				Before.	After.				
Post-Office bar, Willamette River.	Jan. 8 to Feb. 19	29.4	466.4	21	26	300	303,314	6,687	15.8
Gillihan's, Willamette River.	Feb. 19 to Feb. 27	6	123.4	24	27	300	26,079	1,112	-----
Slaughter's bar, Columbia River.	Mar. 2 to May 6	67.4	1,219.8	22.5	25.5	300	463,716	11,406	43.3
Ladu's, Columbia River.	May 12 to May 23	8.7	82.4	24.5	26	300	10,125	604	6
St. John's bar, Willamette River.	May 7 to May 25	25.3	427.8	22	25	300	174,860	5,524	1.4
Foot of Swan Island, Willamette River.	June 25 to June 30	4.4	81	23	26	150 to 300	15,209	742	-----
Total.....		136.2	2,350.8				963,389	26,077	66.5

The dredge *W. S. Ladd* was also operated throughout the entire year, removing 683,208 cubic yards of material. The following table shows the cost of dredging, including the operating expenses, wages, subsistence, etc.:

Amount of material removed .....	cubic yards..	683,208
Operating expenses, wages, subsistence, etc., current repairs .....		\$18,155.17
Coal, 602.946 tons Roslyn, at \$5.....		\$3,014.73
Coal, 362.946 tons Roslyn, at \$5.10.....		1,851.03
Coal, 891.966 tons Roslyn, at \$5.50.....		4,905.81
		9,771.57
Total cost of operating.....		27,926.74
Cost per cubic yard for the year.....	cents..	4.09
Cost per cubic yard for coal.....	do..	1.43
Coal consumed per cubic yard.....	pounds..	6.09
Cubic yards dredged per ton of coal.....		367
Cubic yards per day's dredging.....		2,628

The following is a statement of the total amount of material removed by the dredge since her construction in 1893:

	Cubic yards.
Total to close of fiscal year 1902 .....	3,829,619
1902-3 .....	683,208
Total .....	4,512,827

The appended table shows the locality of dredging by the U. S. dredge *W. S. Ladd*, time, depth of cut, amount of material removed, etc.:

Locality.	Periods at work.	Days work-ing.	Hours pump-ing.	Material moved.	Minimum depth.		Width of dredged cut.	Repair-ing machin-ery.
					Before.	After.		
Cut below Taylor sands.	July 1 to Aug. 24, 1902.	40	214	61,044	14	21	200	2
Cut at upper sands.		-----	-----	51,209	14	20	200	-----
Dobelbower's bar.	Aug. 25 to Oct. 31, 1902	51	291	180,929	18	22½	200	1
Slaughter's bar...	Nov. 1, 1902, to Jan. 31, 1903.	66	329	138,444	18½	21	200	1½
Pillar Rock, upper and lower bar.	Feb. 1 to May 2, 1903.	68	362	214,971	18	22½	300	1½
Harrington Point.	May 3 to June 30, 1903.	37	103	86,611	17½	20½	300	5
Total .....	-----	260	1,299	663,208	-----	-----	-----	11

The port of Portland commission has also operated its 20-inch and 30-inch Bowers dredges at different points, and reports excavation as follows:

	Cubic yards.
Portland Harbor .....	249,155
Post-Office bar .....	237,721
Mouth of Willamette .....	154,406
Willow bar .....	423,000
Martins Island .....	40,800
Total .....	1,105,082

*Surveys.*—A small party was engaged at intervals during the year principally in triangulating at various points and in making low-water surveys at Willow bar and at upper and lower Martins bar. Concrete monuments were erected to mark the stations.

A survey was also made at the head of Coon Island for the purpose of estimating the cost of removing the old revetment at that place. A number of new triangulation stations were also established in the Willamette River and their coordinates calculated.

Besides the above, the party was also engaged on numerous hydrographic surveys in connection with dredging operations and in making surveys of various structures erected under permit of the Secretary of War.

Permanent triangulation of the river has now been practically completed over the most needed portions of the river, aggregating 60 miles in length, and of which approximately 30 miles was triangulated during the past year.

*Miscellaneous.*—The opening of a gap 200 feet wide in Swan Island dike having been authorized, the snag boat *Mathloma* was used to pull the piling and level off the rock. A channel will be dredged through the dike to a depth of 6 feet below low water after the water has receded sufficiently to allow its being done.

Provision having been made for the improvement, with a view of obtaining a depth of 40 feet on the bar at the mouth of the Columbia, it would now seem that Congress should consider the improvement of the channel in the Columbia, with a view to its immediate betterment, and make a liberal appropriation for prosecuting the project to completion. The amount of commerce using the river now, and the

increase that would naturally follow if the bar and river channels were secured and maintained, will certainly warrant the work being carried out at once. The channel is not of sufficient depth to allow of the larger vessels coming to Portland, and it is claimed that considerable transport and other business has been lost to this community on that account. The sum of \$500,000 is therefore named in the money statement as amount that can be expended in the fiscal year 1905 for works of permanent improvement. The amount required for maintenance is \$125,000, which is needed principally for dredging and is essential to maintaining the present conditions. The appropriation of these sums, or \$625,000 in all, will enable the existing channel to be maintained and a beginning made on the permanent works of improvement required. The United States dredge *W. S. Ladd* is getting old, and will need rebuilding within a year or two at most. The amount required for this will also have to come out of any funds available for this work. The full sum of \$625,000 should therefore be appropriated without reduction.

A small index map of the locality is herewith.

This work was in the efficient charge of Mr. Gerald Bagnall, assistant engineer.

*Money statement.*

July 1, 1902, balance unexpended .....	\$252,712.19
December 3, 1902, deposited to account proceeds of sale .....	46.77
	252,758.96
June 30, 1903, amount expended during fiscal year .....	75,911.66
July 1, 1903, balance unexpended .....	176,847.30
July 1, 1903, outstanding liabilities .....	8,507.25
July 1, 1903, balance available .....	168,340.05
(Amount (estimated) required for completion of existing project ...	2,673,509.98
Amount that can be profitably expended in fiscal year ending June 30, 1905, in addition to the balance unexpended July 1, 1903:	
For works of improvement .....	\$500,000.00
For maintenance of improvement .....	125,000.00
	625,000.00
Submitted in compliance with requirements of sundry civil act of June 4, 1897, and of section 7 of the river and harbor act of 1899.	

APPROPRIATIONS.

Lower Willamette, act of—	
June 23, 1866 .....	\$15,000.00
March 2, 1867 .....	30,000.00
July 25, 1868 (allotted) .....	21,000.00
April 10, 1869 (allotted) .....	13,365.00
July 11, 1870 .....	31,000.00
June 10, 1872 .....	50,000.00
	\$160,365.00
Lower Willamette, from Portland to the sea, act of—	
March 3, 1873 .....	20,000.00
June 23, 1874 .....	20,000.00
March 3, 1875 .....	20,000.00
August 14, 1876 .....	20,000.00
June 18, 1878 .....	30,000.00
March 3, 1879 .....	45,000.00
	155,000.00





Lower Willamette and Columbia, from Portland to the sea, including bar at the mouth of Columbia, act of—

June 14, 1880 .....	\$45,000.00	
March 8, 1881 .....	45,000.00	
August 2, 1882 .....	100,000.00	
		\$190,000.00

Columbia and lower Willamette, below Portland, Oreg., act of—

July 5, 1884 .....	100,000.00	
August 5, 1886 .....	75,000.00	
August 11, 1888 .....	100,000.00	
September 19, 1890 .....	100,000.00	
July 18, 1892 .....	150,000.00	
August 18, 1894 .....	50,000.00	
June 3, 1896 .....	100,000.00	
March 3, 1899 .....	150,000.00	
		825,000.00

June, 1899, deposited to credit of appropriation .....	20
May, 1901, deposited to credit of appropriation .....	1.56
Act of June 18, 1902 .....	225,000.00
December 3, 1902, deposited to credit of appropriation, account sales .....	46.77
Total .....	1,555,413.53

CONTRACTS IN FORCE.

*Emergency contract for furnishing coal, delivered in quantities as required, at Astoria, Oreg., and Kalama, Wash.*

Name of contractor: George W. Sanborn.  
 Date of contract: February 19, 1902.  
 Date of approval: March 5, 1902.  
 Date of beginning: Whenever required after date of approval.  
 Date of expiration: December 31, 1902. (Completed.)

*Emergency contract for furnishing coal, delivered in quantities as required, at Portland, Oreg., and Fort Stevens, Oreg.*

Name of contractor: Newton Poston.  
 Date of contract: February 19, 1902.  
 Date of approval: February 28, 1902.  
 Date of beginning: Whenever required after date of approval.  
 Date of expiration: December 31, 1902. (Completed.)

*Emergency contract for furnishing coal, delivered in quantities as required, at Astoria, Oreg., Fort Stevens, Oreg., and Kalama, Wash.*

Name of contractor: George W. Sanborn.  
 Date of contract: December 4, 1902.  
 Date of beginning: Whenever required after date of contract.  
 Date of expiration: December 31, 1903. (In force June 30, 1903.)

*Contract for hire of suction dredge, with tender fully manned, equipped, etc., to be used dredging in Columbia and Willamette rivers.*

Name of contractor: Port of Portland Commission.  
 Date of contract: October 17, 1902.  
 Date of approval: December 13, 1902.  
 Date of beginning: Upon two weeks' notification, any time after date of contract.  
 Date of expiration: June 30, 1904. (In force, whenever dredging is required, until date of expiration.)

## 2268 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

*Emergency contract for furnishing pump castings, delivered to the U. S. dredge "Wm. S. Ladd," Columbia River.*

Name of contractor: Willamette Iron and Steel Works.

Date of contract: January 20, 1903.

Date of beginning: January 20, 1903.

Date of expiration: 60 days from date of contract. (Completed.)

# COMMERCIAL STATISTICS.

*Arrivals and clearances of vessels at Astoria, Oreg., during the year ending December 31, 1902.*

[From collector of customs at Astoria.]

Vessels.	Coastwise.		Foreign ports.		Total.	
	Number.	Tonnage.	Number.	Tonnage.	Number.	Tonnage.
Arrived .....	572	500,122	149	290,808	721	790,925
Cleared .....	572	494,506	18	81,238	590	525,794
Total .....	1,144	994,628	167	322,041	1,311	1,316,719

*Commerce for the year ending December 31, 1902.*

Value of exports .....	\$155,517.00
Value of imports .....	8,304.78
Duties collected .....	2,682.00

Principal items of export are lumber, salmon, flour, wheat, machinery, canned and dried fruit.  
Principal items of import are coal, salt, cement, rice, Chinese wines, and vegetables, etc.

*Arrivals and clearances of vessels at Portland, Oreg., during the year ending December 31, 1902.*

[From collector of customs at Portland.]

Vessels.	Coastwise.		Foreign ports.		Total.	
	Number.	Tonnage.	Number.	Tonnage.	Number.	Tonnage.
Arrived .....	298	354,148	86	75,661	384	429,809
Cleared .....	201	180,881	130	243,127	331	428,508
Total .....	499	534,529	166	322,788	665	858,317

*Commerce for the year ending December 31, 1902.*

Value of exports to foreign countries .....	\$11,548,375.00
Value of imports from foreign countries .....	2,912,585.00
Duties collected .....	832,132.14

*Registered tonnage over Columbia River bar year 1902.*

	Deep-sea sailing vessels.						Coasters.		Total.	
	American.		British.		Other flags.		Num-ber.	Ton-nage.	Num-ber.	Ton-nage.
	Num-ber.	Ton-nage.	Num-ber.	Ton-nage.	Num-ber.	Ton-nage.				
Inward to Astoria and Portland .....	9	6,142	89	189,628	51	95,038	387	332,038	536	622,691
Outward from Portland and Astoria ..	28	18,681	93	233,037	48	101,298	368	271,159	522	624,175

Total freight, foreign and coastwise, carried in and out over the Columbia River bar during calendar year 1902, 1,131,426 tons.



The following statement of traffic on the Columbia and lower Willamette rivers has been compiled from reports of the various steamers and transportation companies doing business on these rivers during the calendar year 1902. This statement does not include freight transported in deep-sea vessels:

Articles.	Tons.	Articles.	Tons.
Wheat.....	16,684	Wool.....	884
Other cereals.....	25,365	General merchandise.....	109,412
Flour.....	36,928	Fish.....	15,855
Piles (1,954,937 linear feet).....	39,069	Sand and gravel.....	176,281
Lumber (116,264,000 feet B. M.).....	151,143	Stone.....	223,806
Logs (813,922,000 feet B. M.).....	627,844	Wood (21,566 cords).....	32,347
Shingles.....	2,136	Hay.....	9,243
Cattle and horses (9,596).....	3,838	Hops.....	99
Sheep and hogs (2,881).....	2,010	Fruit.....	10,274
Potatoes.....	23,936		
Coal.....	762	Total.....	1,567,386

Passengers carried, 196,097.

*Statement showing principal articles and tonnage of foreign exports and imports at Portland, Oreg., during the calendar year 1902.*

Exported.		Imported.	
Articles.	Tons.	Articles.	Tons.
Wheat.....	819,508	Coal.....	18,556
Flour.....	67,764	Manila and jute.....	1,806
Barley.....	14,244	Sulphur.....	2,414
Timber.....	51,532	Bags.....	491
Canned salmon.....	244	Rice.....	8,098
Cotton.....	2,611	Sugar.....	17
Liquor.....	123	Tea.....	177
Paper.....	42	Coffee.....	93
Salt beef.....	210	Salt.....	7,699
Oats.....	10,623	Cement.....	24,135
Hay.....	8,179	Window glass.....	642
Cloth.....	6,677	Pig and bar iron.....	8,359
		Spirits.....	704
		Matting.....	205
		Clay.....	1,859
Total.....	476,847	Total.....	64,955

*List of vessels plying the Willamette and lower Columbia rivers and their tributaries, between Portland and Astoria, Oreg.; the upper Willamette and Yamhill rivers and their tributaries above Portland, Oreg., during the calendar year 1902, furnished by the inspectors of boilers and hulls at Portland, Oreg.*

Name of vessel.	Net tonnage.	Depth.	Name of vessel.	Net tonnage.	Depth.
		<i>Ft. in.</i>			<i>Ft. in.</i>
Albany.....	401	4 5	Elmore.....	467	4 5
Altona.....	189	5 2	Enterprise.....	187	8 8
America.....	67	6 2	Elkador.....		
Astorian.....	234	7 5	Eugene.....	271	5 8
Bailey Gatzert.....	444	8 0	F. B. Jones.....	198	7 0
Brick.....	84	4 6	Fannie.....	276	6 6
Canby.....	49	5 4	Florence.....		
Cascades.....	227	6 0	Flyer.....	258	15 0
Charles R. Spencer.....			G. H. Mendell.....	90	7 0
Chester.....	98	8 8	Glenola.....	276	2 4
City of Eugene.....	214	4 5	G. M. Walker.....	125	4 2
Clara.....			Game Cock.....	658	7 8
Columbia.....	1,788	14 4	Geo. W. Elder.....	1,224	21 0
Colwell.....	11	8 5	Grey Eagle.....	162	4 7
Cygnets.....			Harvest Queen.....	667	7 0
Dallas City.....	296	7 0	Hassalo.....	350	6 5
Dovie.....	7	8 5	Hercules.....	298	8 6
Eclipse.....	25	5 6	Hoo-Hoo.....	16	8 2
Edith.....	87	9 3	Hustler.....	129	7 0
Electro.....	80	5 8	Ione.....	213	5 0
El Hurd.....	28	6 2	Iralda.....	36	6 6

## 2270 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

*List of vessels plying the Willamette and lower Columbia rivers and their tributaries, etc.—Continued.*

Name of vessel.	Net tonnage.	Depth.	Name of vessel.	Net tonnage.	Depth.
		<i>Ft. in.</i>			<i>Ft. in.</i>
James B. Stephens .....	26	3 0	Regulator .....	334	6 5
Jordan .....			Republic .....	60	5 0
Joseph Kellogg .....	272	3 4	R. Miller .....	56	6 8
Kehani .....	85	6 0	R. R. Thompson .....	912	9 6
Katie Weir .....	5		Resolute .....	12	5 0
Lizzie .....	21	6 4	Robt. T. Lincoln .....	50	7 0
Leona .....	133	4 0	Ruth .....	888	4 6
Lurline .....	338	6 6	Samson .....	189	15 6
Mathloma .....	270	4 0	Sarah Dixon .....	278	6 5
Maria .....	184	5 9	Sue H. Elmore .....	131	8 0
Mayflower .....	82	6 0	Tacoma .....	1,311	11 7
M. F. Henderson .....			Tahoma .....	154	6 0
Mascot .....	199	5 0	Tatoosh .....	154	15 5
Metlako .....	122	4 8	T. J. Potter .....	589	10 6
Modoc .....	337	4 4	Undine .....	280	6 6
N. R. Lang .....	381	6 2	Vanguard .....	51	4 8
Nahcotta .....	112	6 5	Volga .....	48	4 0
Nellie .....	59	4 2	Vulcan .....	219	7 0
Nellie .....	7	4 0	Wallula .....	85	12 6
Naiad .....	8	4 0	Wenona .....	34	6 2
Northwest .....	301	4 8	Wilavis .....	11	3 9
No Wonder .....	235	5 6	W. H. Harrison .....	52	6 8
Ocklahoma .....	565	8 3	Wm. M. Hoag .....	431	5 6
O. K. .....	47	5 2	W. S. Mason .....		
Pomona .....	295	6 1	Wm. S. Ladd .....	700	12 0

## X X 4.

IMPROVEMENT OF COLUMBIA RIVER BELOW TONGUE POINT,  
OREGON.

## OPERATIONS DURING THE FISCAL YEAR 1903.

Work was continued under contract dated October 20, 1900, with E. T. Johnson, for rock excavation and dredging, the time for completion having been extended. On October 14, 1902, the work had all been completed. During the year the following material was excavated and placed along the line of the Astoria and Columbia River Railroad:

	Cubic yards.
Rock excavation above grade .....	2,303
Rock excavation between grade and 1 foot below grade .....	1,167
Sand excavation .....	1,701
Total excavated .....	5,201

The contractor's plant consisted of one dredge and two dump scows.

The work done has benefited the channel and obtained a depth of 25 feet across a point of Sylvia de Grasse Reef, besides widening the channel.

The work was in immediate charge of William E. Morris, assistant engineer, under supervision of Gerald Bagnall, assistant engineer.

*Money statement.*

July 1, 1902, balance unexpended .....	\$49,894.14
June 30, 1903, amount expended during fiscal year .....	24,544.73
July 1, 1903, balance unexpended .....	25,349.41

## APPROPRIATIONS.

June 3, 1896, from unexpended balance to the credit of improving mouth of Columbia River, Oregon and Washington.....	\$50,000
Act of March 3, 1899.....	71,000
Total.....	121,000

## CONTRACTS IN FORCE.

The only contract in force was with E. T. Johnson, of Portland, Oreg., which provided for excavating 4,500 cubic yards of rock, more or less, at \$6 per cubic yard, and 10,000 to 12,500 cubic yards of sand, at 50 cents per cubic yard. The contract was approved November 19, 1900. Work was commenced January 7, 1901, and completed October 14, 1902. The contract provided that the whole work be completed within nine months, but owing to delays on account of accidents and stress of weather the time for completion was extended.

## COMMERCIAL STATISTICS.

The tonnage over these waters is shown in report for improving Columbia and lower Willamette rivers, below Portland, Oreg., and includes nearly all wheat shipments, most of the lumber and produce, and a greater portion of all imports using the Columbia River.

## X X 5.

## IMPROVEMENT OF THE MOUTH OF COLUMBIA RIVER, OREGON AND WASHINGTON.

Reference is respectfully invited to the report on the project for increasing channel depths at the mouth of the Columbia River, printed in House Document No. 94, Fifty-sixth Congress, first session, and also in report of the Chief of Engineers for 1900, Part VI, pages 4439 et seq., for a history of the work and full details, maps, and charts of the proposed extension of the jetty, with estimates of cost.

## OPERATIONS DURING THE FISCAL YEAR 1903.

At the beginning of the present fiscal year the work of repairing the jetty tramway, putting the plant into condition, and other preparatory work was in progress under appropriation of \$500,000 made by act of June 13, 1902, for continuing the improvement. This act also authorized contracts not exceeding \$1,000,000. Up to this time such repairs as had been completed were done under appropriation of \$250,000 made by act of June 6, 1900.

With the funds available for this work, the repairs to the jetty, including the repairs to approaches, tramway, plant, change of quarters, rearrangement of tracks, all rolling stock, pile drivers, etc., and everything connected with the work was gotten in readiness to begin actual work of jetty extension so soon as notification was received that the report of the Board of Engineers had been approved. The

report of the Board was not completed until January 24, 1903, and did not receive the approval of the Secretary of War until March.

The project submitted by the Board of Engineers, constituted by Special Orders, No. 19, paragraph 11, Headquarters Corps of Engineers, July 5, 1902, is but a slight modification of the latest approved project and, according to the estimate of the Board, can be carried out without increasing the cost over that of the previous project. It consists in extending the jetty seaward some  $2\frac{1}{4}$  miles. The thought is also expressed by the Board that to secure the desired depth and a practicable width of channel the construction of a north jetty will perhaps be necessary at some future time. Dredging is also recommended.

Upon notification that the project had been approved, proposals were at once issued for furnishing piles, lumber, iron, steel, etc., and emergency contracts were made, and nearly all the material that enters into the construction of the jetty tramway has since been received. An emergency contract for the delivery of 150,000 tons of rock and formal contract for delivery of 475,000 tons have been entered into with the Northwest Construction Company, of Astoria, Oreg. The one for the larger amount is not yet in force, as delivery will not begin until the contract for the smaller amount is completed. Under the smaller contract, which has been in force about one month, but little stone has yet been received and dumped.

The operations during the year have resulted in the redriving of a part of the washed-away portion of the jetty tramway; the decayed piles were cut off and spliced, new stringers and ties laid, and the tracks put in good order. At the close of the fiscal year this work had advanced to station 243+60, a distance of 1,818 feet. This brings the outer end of the jetty tracks within 640 feet of the end of the old work. Storage platforms were constructed near station 152+00, and on Clatsop Spit storage platforms were also built for the storage of material to be used in construction. It was found that the water supply would be entirely inadequate for the new work and three new wells were sunk to a depth of 81 feet, pumps installed and water pipes laid, and a plentiful supply of excellent water has been obtained. Three new locomotives were purchased, new pile-driver tender car built, and 15 dump cars added to the 80 previously built.

For the receipt of stone which is to be delivered by rail a new system of tracks had to be installed and new derricks constructed, and this plant, at the close of the fiscal year, is in a very satisfactory condition, and it is expected that 2,500 tons of stone per day may be conveniently handled. The quarters and buildings have been put in repair, and two additional quarters constructed for use of the men. The office and commissary buildings were moved back a distance of about 60 feet in the clear.

*Dredging.*—The United States transport *Grant* has been transferred to the Engineer Department by the War Department, and is now being fitted up at San Francisco, Cal., for use as a dredge for deepening the channel over the bar.

*Reclaiming sand spits.*—Under the direction of Prof. A. V. Stubenrauch, assistant horticulturist, University of California, 100 sacks of sand-binding grasses *Ammophila arenaria* roots, and one sack of seed were planted on the reservation in a "nursery," where the drifting sands would not cover them, and in addition to this a number of roots were planted on Clatsop spit. It is the intention to set out large

numbers of sand-bearing plants on these spits, as well as in the vicinity of gun emplacements under construction, next fall, from the nursery, and gradually increase the area to be reclaimed.

*Surveys.*—An examination was made of the bar in January, with the view of ascertaining the changes which had taken place since the survey of June, 1902. The soundings taken showed a possible shoaling in the north channel and a somewhat increased depth of the south channel. The harbor throat also showed increase in depth.

The survey of the bar was commenced in June, but owing to rough weather and some slight repairs to the boiler of the tug, was not completed until July 8. The map of this survey \* \* \* shows very little change from the survey of June, 1902. The depth of the north channel has decreased, and that of the south channel has increased by about 1 foot, thus making the navigable depths at the close of the year 20 feet, with a narrow channel of 21 feet, and 21 feet with a narrow channel of 23 feet, respectively, at the average of the lowest low water. Peacock spit shows a further seaward movement of the 18-foot curve of about 1 mile. There is practically no change in Clatsop spit nor in the outer 24-foot curve, while the inner 24-foot curve has advanced seaward, making the distance between the inner and outer 24-foot curves less than half a mile.

The total cost of the project, as estimated by the Board of Engineers, including the south jetty, north jetty, and dredging, is \$3,715,000, of this sum \$1,500,000 has been appropriated, leaving \$2,215,000 needed for completion of the project.

The estimated cost of the south jetty is \$2,260,000. From the already appropriated funds it is proposed to pay the expense of remodeling the transport *Grant* and operating it as a dredge, and a very conservative estimate of funds required for this purpose is approximately \$500,000. As this expenditure will reduce the amount available for the south jetty by that amount, future appropriations should be large enough to supply this deficiency. The amount shown in the money statement, \$1,260,000, should therefore be appropriated to insure no further delay to this important work.

This work has been in the efficient charge of Mr. G. B. Hegardt, assistant engineer.

#### *Money statement.*

July 1, 1902, balance unexpended .....	\$523,454.39
Amount appropriated by sundry civil act approved March 3, 1903 ..	1,000,000.00
Amount deposited December 3, account proceeds of sale .....	56.81
	<hr/>
June 30, 1903, amount expended during fiscal year .....	1,523,510.70
	89,665.59
July 1, 1903, balance unexpended .....	1,433,845.11
July 1, 1903, outstanding liabilities .....	21,706.00
	<hr/>
July 1, 1903, balance available .....	1,412,139.11
	<hr/>
July 1, 1903, amount covered by uncompleted contracts .....	575,526.00
	<hr/>
{ Amount (estimated) required for completion of existing project ..	2,215,000.00
{ Amount that can be profitably expended in fiscal year ending June	
{ 30, 1905, in addition to the balance unexpended July 1, 1903. ....	1,260,000.00
{ Submitted in compliance with requirements of sundry civil act of	
{ June 4, 1897.	

## 2274 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

## APPROPRIATIONS.

Act of—	
July 5, 1884 .....	\$100,000.00
August 5, 1886 .....	187,500.00
August 11, 1888 .....	500,000.00
February 22, 1890 .....	75,000.00
September 19, 1890 .....	475,000.00
July 13, 1892 .....	850,000.00
August 18, 1894 .....	338,180.00
	2,025,680.00
Act of June 3, 1896, transferred to credit of improvement of Columbia River below Tongue Point .....	50,000.00
	1,975,680.00
Sundry civil act of June 6, 1900 .....	250,000.00
November, 1900, deposited to credit of appropriation .....	2.00
Act of June 13, 1902 .....	500,000.00
December 3, 1903, deposited to credit of appropriation, account sales .....	56.31
Sundry civil act of March 3, 1903 .....	1,000,000.00
Total .....	3,725,738.31

## CONTRACTS IN FORCE.

*Emergency contract for furnishing coal, delivered in quantities as required, at Portland, Oreg., and Fort Stevens, Oreg.*

Name of contractor: Newton Poston.  
Date of contract: February 19, 1902.  
Date of approval: February 28, 1902.  
Date of beginning: Whenever required after date of approval.  
Date of expiration: December 31, 1902. (Completed.)

*Emergency contract for furnishing double-cylinder engine and pile-driver machinery delivered at Fort Stevens, Oreg.*

Name of contractor: Columbia Engineering Works.  
Date of contract: October 2, 1902.  
Date of beginning: Within ten days from date of contract.  
Date of expiration: Within one hundred and twenty days from date of beginning. (Completed.)

*Emergency contract for furnishing three locomotives delivered at Fort Stevens, Oreg.*

Name of contractor: Burnham-Williams & Co.  
Date of contract: October 25, 1902.  
Date of expiration:  
One locomotive to be delivered April 1, 1903.  
One locomotive to be delivered May 1, 1903.  
One locomotive to be delivered June 1, 1903.  
The delivery of locomotive required April 1, 1903, was extended for a reasonable period. Contract was fully completed June 1, 1903.

*Emergency contract for furnishing coal, delivered in quantities as required, at Fort Stevens, Oreg.; Astoria, Oreg., and Kalama, Wash.*

Name of contractor: George W. Sanborn.  
Date of contract: December 4, 1902.  
Date of beginning: Whenever required after date of contract.  
Date of expiration: December 31, 1903. (In force June 30, 1903.)

*Emergency contract for furnishing piles, in lengths and quantities stipulated in specifications attached to contract, delivered at Fort Stevens, Oreg.*

Name of contractor: Oregon Rafting Company.  
 Date of contract: March 24, 1903.  
 Date of expiration:  
   One lot delivered by April 15, 1903.  
   One lot delivered by May 15, 1903.  
   One lot delivered by June 15, 1903. (In force June 30, 1903.)  
   One lot delivered by July 15, 1903.  
 The time for delivery of each lot was extended fifteen days.

*Emergency contract for furnishing iron, steel, etc., delivered at Fort Stevens, Oreg.*

Name of contractor: Corbett-Failing & Robertson, Inc.  
 Date of contract: March 25, 1903.  
 Date of expiration:  
   One lot delivered by April 1, 1903.  
   One lot delivered by May 1, 1903.  
 The time for delivery of each lot was extended for fifteen days, and for delivery of 8-inch cut spikes to June 1, 1903. (Completed.)

*Emergency contract for furnishing lumber, in sizes and quantities stipulated in the specifications attached to the contract, delivered at Fort Stevens, Oreg.*

Name of contractor: Warren & Lester.  
 Date of contract: March 28, 1903.  
 Date of expiration:  
   One lot delivered by April 10, 1903.  
   One lot delivered by May 10, 1903.  
   One lot delivered by June 10, 1903. (In force June 30, 1903.)  
   One lot delivered by July 10, 1903.  
 The time for delivery of each lot was extended twenty-one days.

*Emergency contract for furnishing 150,000 tons of rock, delivered at Fort Stevens, Oreg.*

Name of contractor: Northwest Construction Company.  
 Date of contract: May 27, 1903.  
 Date of beginning: Within twelve days from date of contract.  
 Date of expiration: Deliveries to be made in accordance with specifications.

*Contract signed, but not in force, for furnishing 475,000 tons of stone, delivered at Fort Stevens, Oreg.*

Name of contractor: Northwest Construction Company.  
 Date of contract: May 27, 1903.  
 Date of approval: Not known.  
 Date of expiration: Deliveries to be made in accordance with specifications.

---

 COMMERCIAL STATISTICS.

For commercial statistics, see report on improving Columbia and lower Willamette rivers below Portland, Oreg.

---

 REPORT OF BOARD OF ENGINEERS ON PROJECT FOR IMPROVEMENT OF MOUTH OF COLUMBIA RIVER.

UNITED STATES ENGINEER OFFICE,  
 New York, N. Y., January 24, 1903.

GENERAL: Paragraph 11, Special Orders, No. 19, Headquarters, Corps of Engineers, U. S. Army, July 5, 1902, constituted a Board of Officers of the Corps of Engineers, consisting of three members, "to

consider and report upon the project for improving the mouth of Columbia River, Oregon and Washington." By Special Orders, No. 35, same headquarters, September 13, 1902, the Board was increased to five members by the addition of two officers.

Pursuant to the above orders, and the call of the senior member, the Board met at Portland, Oreg., September 18, 1902, for the consideration of the adopted project for the improvement of the Columbia River. \* \* \*

Proceeding to the mouth of the Columbia River the Board made an examination on September 19 of that locality and of the jetty heretofore constructed for its improvement. On September 20 the Board held a public hearing in Portland, Oreg., at which all interested parties were given an opportunity to present their views, and on the same day adjourned to meet in New York City on October 14, 1902, in accordance with instructions from the Chief of Engineers, dated August 19, 1902. \* \* \*

Pursuant to this adjournment the Board met in New York City on the date named. \* \* \* The Board afterwards proceeded to Aransas Pass, Tex. \* \* \* On January 12, 1903, the Board again assembled in New York City and remained in session until the consideration of the business before it was concluded.

After a thorough and careful consideration of the subject before it, the Board has now the honor to submit the following report. \* \* \*

The order constituting the Board requires it only "to consider and report upon the project for improving the mouth of the Columbia River, Oregon and Washington," without requiring an expression of opinion as to the desirability of continuing that improvement. In view of the recommendations contained in the following report, the Board feels no hesitation in expressing its opinion of the importance and necessity of the proposed improvement without entering into any explanation of the well-established facts upon which that opinion is based.

The project referred to the Board for its consideration is that proposed by Maj. W. C. Langfitt, Corps of Engineers, in accordance with a provision contained in the river and harbor act of March 3, 1899, as follows:

Mouth of Columbia River, Oregon and Washington: Survey and estimates with a view to obtaining a channel of forty feet depth at lowest low water, and a report as to the desirability of such improvement.

Major Langfitt's project is contained in his report of November 6, 1899, as printed in House Document No. 94, Fifty-sixth Congress, first session, and reprinted in the Annual Report of the Chief of Engineers, United States Army for 1900, pages 4430-4453. This project received the approval of Congress by the appropriation of \$250,000 contained in the sundry civil act of June 6, 1900:

For the repair of the jetty at the mouth of Columbia River, Oregon and Washington, including repairs to wharves, approaches, tramway, plant, quarters, and buildings, and contingent expenses.

It was again approved by Congress in the item of the river and harbor act of June 13, 1902, for—

Improving the mouth of Columbia River, Oregon and Washington: Continuing improvement in accordance with the latest approved project and such modification thereof as may be approved by the Secretary of War, five hundred thousand dollars: *Provided*, That a contract or contracts may be entered into by the Secretary of War for such materials and work as may be necessary to prosecute the approved



and modified project, to be paid for as appropriations may from time to time be made by law, not to exceed in the aggregate one million dollars, exclusive of the amounts herein and heretofore appropriated: *Provided further*, That such modifications shall not cause the total cost of the work to exceed that of the latest approved project.

An elaborate description of the entrance to the Columbia River does not appear necessary in view of its well-known character, and only its most prominent characteristics will be mentioned at present. Such physical facts as relate to the question of its improvement will be taken up later in detail.

#### DESCRIPTION OF THE COLUMBIA RIVER ENTRANCE.

The entrance to the Columbia River lies between a high rocky headland, Cape Disappointment, on the north and a low sand point, Point Adams, on the south. Joining these two points is the Columbia River bar which, measured along its crest, has had lengths of from 10 to 12 miles from point to point. The projection of the bar seaward from a north and south line, through Cape Disappointment light, was  $2\frac{1}{2}$  miles in 1881 and  $3\frac{1}{2}$  miles in 1902, the distance in each case being to the outer 30-foot contour.

Point Adams is the northern extremity of the beach that extends up the coast from Tillamook Head, the headland next south of the entrance and distant 23 miles from Cape Disappointment. Point Adams has been unstable in position and in 1881 was about 6 miles SSE. of Cape Disappointment. From Point Adams there has always extended in a NNW. direction a shoal, Clatsop Spit, whose length and area has varied greatly from time to time with the position of the channel or channels. By the construction of the existing jetty Clatsop Spit was gradually raised above high water nearly to the jetty end and has become an extension of Point Adams. The shore line has thus been advanced about 3 miles since 1889 and the entrance contracted to that extent. The end of the jetty has, in fact, become the south point of the entrance in so far as concerns the future improvement of the bar channel.

About Cape Disappointment also there have always been shoals, Peacock Spit, that have likewise varied widely in extent and area. East of Cape Disappointment lies Bakers Bay, which has at times been in part occupied by the channel, but which since 1885 has been of little depth throughout. Sand Island occupies a large part of the channel face of Bakers Bay and the Chinook Spit, of the earlier surveys, lies at its eastern end.

Between the north and south spits there have ordinarily been found intermediate shoals known as the Middle Sands, which have been connected at different times either to Peacock Spit, when but one channel existed (1885), or to Sand Island when there were two channels (1868).

At Point Adams the width of the river between the Fort Stevens wharf and Chinook Point is about 3 miles. Upstream from Point Adams there are much greater widths occupied by shoals and numerous channels. All existing survey records show the Point Adams section occupied by two channels, between which lies the Middle Ground, whose downstream end, as shown by the 18-foot contour, is three-fourths of a mile below the Fort Stevens wharf and has not changed materially in position since 1868. Of these two channels the southerly or Fort Stevens channel has always been, so far as is known, the ship

channel leading to Astoria and the upper river. The northerly or Chinook Point channel leads into many smaller ones that become lost in the shoals above. Below Point Adams the channel conditions have varied largely in the last century, although there is shown by all the surveys a junction of the two channels, or at least a passage between them (1839). At this junction there existed until after the present jetty was constructed a shoal across the Fort Stevens channel on which the depth has been as little as 18 or 19 feet.

#### HISTORY OF THE ENTRANCE.

The earliest known chart of the entrance is a sketch made by Admiral Vancouver in 1792. The other known early surveys were by Sir Edward Belcher in 1839, Captain Wilkes in 1841, and the United States Coast Survey in 1850, 1852, and 1868. Surveys or examinations have been made by the Corps of Engineers, United States Army, in each year since 1875 excepting 1877, 1884, 1887, and 1888.

The 1792 map shows the junction of the two inside channels and a single channel running almost due west to the sea, with a deep pocket making north into Baker's Bay close under Cape Disappointment. Across the bar there is shown a depth of 27 feet and on the Fort Stevens bar a depth of 18 feet. Clatsop Spit appears with a very large development to the north and to the west, particularly to the west, while Peacock Spit extends but a short distance south of Cape Disappointment and not so far to the west as Clatsop Spit. This map is made on a small scale, without much hydrographic detail, and the plane of reference for the soundings is unknown.

The 1839 survey resulted in the first complete chart of the entrance. The plane of reference to which its soundings were reduced is unknown, but was probably a low water. This survey exhibited a marked change since 1792. The two channels in the Point Adams-Chinook Point section remained practically unchanged, but each was prolonged to the sea by a separate channel. The Point Adams channel extended almost due west as a south channel, pointing to the southwest on the bar crossing where the controlling depth was 19 feet. The north channel ran from Chinook Point northwest through Bakers Bay to Cape Disappointment. East of the Cape it bent abruptly toward the south and thence to the southwest, in which latter direction it crossed the bar with a ruling depth of 27 feet. The north channel was wide and deep, with depths not less than 36 feet from Chinook Point to the bar and maximum depths of 84 and 90 feet inside the Cape. The shoals between the two channels extended continuously from the Middle Ground to the sea. Their most prominent feature were the Sand Island shoals which were located across the center of the entrance and extended in a northwesterly direction from the Middle Ground to within three-fourths of a mile of the Cape. Across these shoals and between them and the Middle Ground was a connection between the two channels on which the depth was 25 feet. Between the sea ends of the two channels were the Middle Sands, extending 4 miles in a southwesterly direction almost at right angles to the Sand Island shoals, with which they were connected. These Middle Sands had ruling depths over them of from 15 to 18 feet excepting at one point, 2 miles from the sea, where the depth was as much as 24 feet and a 21-foot connection existed between the north and south channels. The Middle Sands were submerged to depths of 2 or more fathoms and no part of the Sand Island shoals reached to high water. Clatsop Spit extended

west from Point Adams, and but very little north of it. Peacock Spit extended nearly 3 miles in a SSW. direction from Cape Disappointment to the north channel. No development of the shoalest parts of these spits was made by soundings and their relative heights are indeterminate.

The above description of the entrance, as it existed in 1839, is given this much in detail for the reason that, excepting for the progressive changes noted hereafter, it is typical of the two-channel condition that continued for forty years and until after 1880.

By 1850 the two inside channels had made a junction between the Middle Ground and Sand Island shoals with deep water in each channel. The south channel had deepened inside the bar and moved to the north, but west of Sand Island it ran southwest to the sea with but 19 feet depth across the bar. The north channel through Bakers Bay retained about the same position but had shoaled to 22 feet. From Cape Disappointment it ran SSW. to the sea, parallel to and  $2\frac{1}{2}$  miles from the south channel, from which it was separated by the Middle Sands. The latter had shoaled materially and showed on the chart as a long tail extending SSW. from Sand Island. Sand Island shoals had shortened and moved northwest nearer the cape. Clatsop Spit had grown toward the northwest and lost on the west, while Peacock Spit showed no marked change. The soundings of the 1850 survey are reduced to mean low water and of the 1852 and all later surveys to the plane of the mean of the lower low waters.

The changes in progress during the 1839-1850 period continued to 1868. Clatsop Spit had increased greatly in importance and assumed the shape so well known from the later surveys. It had extended 1 mile northwesterly and shoaled over its whole area, excepting where crossed by a swash channel close to Point Adams. With the growth of Clatsop Spit the south channel and Sand Island, which had risen above high water, were pushed to the north. The former ran to the west past Sand Island and then bent to the south in a quadrant of a circle, being wide and deep inside the bar and having a wide bar crossing with a best depth of 27 feet. The Middle Sands extended west from Sand Island and then south parallel to the south channel. They had lost in width but had apparently gained in elevation. The north channel had deteriorated throughout and had a depth of 21 feet both in Bakers Bay and on the bar. Passing Cape Disappointment, it ran SSW. and thence SW. along the north face of the Middle Sands and across the bar. With the extension of Clatsop Spit there had formed across the mouth of the Point Adams channel a shoal that connected the spit with the Middle Ground and continued to obstruct that channel until after the jetty was constructed.

The 1868 survey shows the south channel in its best condition. With the continued growth of Clatsop Spit the south channel was pushed still farther north with a resulting corresponding movement of Sand Island and the gradual obliteration of the Middle Sands. By 1881 the Middle Sands, as they existed in 1868 as an effective barrier on the north of the south channel, had almost disappeared and a breach had been made through them connecting the two channels. During this period Clatsop Spit had lost in elevation and had failed to follow the south channel in its widening to the west. As a result of these two causes the south channel had deteriorated and covered the entire southwest quadrant of the bar, although its best depth, 19 feet, was found in a southerly direction near Clatsop Spit. The north channel had deepened on the bar crossing (23 feet in 1878-79 and

21 feet in 1881), where it pointed to the NW. after running SSW. past Cape Disappointment, but in Bakers Bay it had shoaled to 14 feet and ceased to be used as a channel.

The above channel history may be summarized in a few words. Clatsop Spit subsequent to 1839 steadily increased in length, area, and elevation, reaching its maximum elevation probably about the time of the 1868 survey, but continuing to lengthen to the end of this period, 1881. The south channel, assumed to be the development of a swash channel across an earlier Clatsop Spit, moved north with the growth of Clatsop Spit while its outer end remained in about the same position as in 1839, the bar crossing always pointing to the south of west. It increased in depth to 27 feet in 1868 and then deteriorated again to 19 feet in 1881, with the changes in Clatsop Spit and the Middle Sands. The Sand Island shoals, assumed to be the detached remnant of an earlier Clatsop Spit, moved steadily north and increased in elevation but decreased in area. The Middle Sands, trailing seaward from the Sand Island shoals, increased in area to 1851 and in elevation to 1868 and decreased in each subsequent to those dates. The north channel, which in 1839 was wide and deep through Baker's Bay and carried 27 feet across the bar, steadily deteriorated throughout after 1852, shoaling to 19 feet at both ends. It retained its southwest direction across the bar until the later seventies and then swung around to the northwest. Peacock Spit retained its position practically unchanged during the entire period, but in 1881 it had but two-fifths of its maximum length of 1851.

In 1882 a project for the improvement of the entrance was prepared by a Board of Engineers under authority contained in the act of August 2, 1882. The report of this Board was printed in Senate Executive Document No. 13, Forty-seventh Congress, second session, and in the Report of the Chief of Engineers for 1883, pp. 2011-2037. This report, and the works recommended therein and by a later Board (1893), will be considered in detail subsequently.

After 1881 the north channel continued to deteriorate and by 1885 it had practically disappeared. Since that time there has been but one channel, the old south channel, which retained without material change its location and depth across the southwest section of the bar until 1889. Clatsop Spit continued to grow to the north and west until even a later date, but lost in elevation until reenforced by the construction of the jetty. Its most marked development was the appearance in or before 1881 of a new swash channel near Point Adams, which continued to grow in width and depth until after 1885 and promised, if not checked, to develop into a new south channel similar to that of 1839. Sand Island and the channel north of Clatsop Spit were pushed farther north, and this movement continued until the sand movement on Clatsop Spit was controlled by the construction of the jetty designed by the Board of 1882. The Middle Sands as an appendage to Sand Island disappeared, but remained as the outer crest of the bar and a barrier directly across the entrance. Peacock Spit to 1889 gradually shortened in a north and south direction, but grew extensively to the southwest along the crest of the bar. Baker's Bay became an area of shoals and has so continued to the present time.

The project of the Board of 1882 provided for a jetty running northwesterly across Clatsop Spit. Its construction was begun in 1885, but proceeded so slowly as not to affect the condition of the bar channel until 1889. Rapid construction commenced in 1889 and its effect on

the bar was immediately noticeable. The channel, which since 1881 had hugged the western side of Clatsop Spit, straightened out toward the west, although all of the southwest quadrant of the bar was of nearly uniform depth. As the construction of the jetty proceeded the channel continued to swing toward the north and increase in depth progressively until 1895, when it had a maximum depth of 31 feet and a channel depth of 30 feet for a width of seven-eighths of a mile. At this time, 1895, the channel ran almost due west from Sand Island to the bar and was in its best known condition. The swing to the north continued, however, and the depth decreased slowly to 28 feet in 1899, and then rapidly to 24 feet in 1900, 23 feet in 1901, and 22 feet in 1902, by which time the remains of the old bar channel pointed nearly due north and two new channels of almost equal depth had become apparent. During this swing of 6 miles from the southerly location of 1885 and of 4 miles from the southwesterly position of 1889 the channel across the bar pointed persistently toward the southwest until 1897. Between 1897 and 1898 a marked change occurred, and the bar channel swung through an arc of 60° to the northwest, followed by the rapid deterioration in depth that occurred after 1899.

During this period of jetty construction from 1889 to 1895, and the subsequent period of channel deterioration after 1895, many changes in the physical characteristics of the channels, spits, and the crest of the bar were making progressively. A discussion of them in their relation to the improvement of the entrance will be found below. A detailed description and history of the entrance, compiled from the records of surveys as shown on existing charts and in extension of a similar description accompanying the report of the Board of 1882, is attached hereto (Appendix A), with a tabulated statement of the depths on the inner and outer bars as shown by the charts of the various surveys.

#### PHYSICAL DATA.

From Cape Disappointment the beach is continuous for 23 miles to Tillamook Head with the exception of the break made by the mouth of the Columbia River. From Tillamook Head to within about 5 miles of Point Adams the beach accumulation of sand is comparatively narrow, with high bluffs within 1 or 1½ miles of the coast line. The river is confined between rocky, permanent banks at the Astoria-Point Ellice section, 5 miles east of Point Adams, and the limits within which it has been possible for the entrance to shift are restricted therefore to the 11-mile section south or southeast of Cape Disappointment. Since 1792, and probably a much earlier date, the entrance has been confined to the 6-mile section south of the cape, and within this section its channels have varied widely in position.

The ocean beach and bed in the vicinity of the Columbia River entrance and the many spits, bars, and shoals, both within and without that entrance, are composed of a fine sand that is readily shifted from point to point by the prevailing currents, particularly when placed in suspension by the action of the incessant surf of this coast. It is thus molded into shapes whose configuration best indicates for the time being the resultant of the forces that lead to sand movements.

The origin of this sand is not susceptible of exact determination. Part of it is undoubtedly due to the slow degradation of the coast cliffs by wave action and other causes, but there appears to be no reasonable doubt that the bulk of it was originally brought from the interior by the Columbia River, which drains an immense area and is

the only large stream between San Francisco and the entrance to Puget Sound. The Columbia is not ordinarily classed as a sediment-bearing stream. For the greater part of the year its waters are clear, but during periods of freshets, which are usually of several months' duration in each year, it carries material in suspension and pushes more along its bed. This material forms the bars and shoals that exist in the upper river and encumber so extensively its lower portion, finally and progressively reaching the sea. Evidence of this origin of the sand is found in the general map of the coast from Cape Lookout north 110 miles to Grays Harbor (U. S. Coast and Geodetic Survey, No. 6100). Between Cape Lookout and Tillamook Head, a distance of 40 miles, there are the mouths of several of the small coast streams, but the beach is uniformly narrow with no marked protuberances, and the 30-fathom contour remains at an almost uniform distance of 3 miles from the coast. Passing Tillamook Head the 10 and 30 fathom contours gradually push out from the coast, the latter to a distance of 8 miles opposite the Columbia River entrance and of 9 or 10 miles at a point 12 miles north of Cape Disappointment; this last distance is maintained to the limits of the chart. The beaches also increase in importance to the north, and submerged bars project prominently at the Columbia River, Shoalwater Bay, and Grays Harbor. These indications not only point to the Columbia River as the origin of the major part of the beach sand, but they also indicate that the bulk of this Columbia River sand ultimately drifts to the north after reaching the beach. While the amount of this sand is enormous when expressed in figures, it nevertheless is relatively small in comparison to that found on many other beaches and about the entrances of sediment-bearing streams of the size of the Columbia. Moreover, the shifting sand about the Columbia River entrance appears to be limited in amount, and not to be increasing to a troublesome extent by additions from the river or from the beaches to the south of Tillamook Head. Indeed, the Board believes that the majority of the changes on the spits and beaches about entrance during the last forty years can be reasonably accounted for as due to local movements of sand already in existence between Tillamook Head and Mackenzie Head, with the addition of such as is annually brought down by the river. Further consideration will be given subsequently to the details of this sand movement.

As is the case in all similar ocean bars the active forces that shape the spits and channels forming the Columbia River entrance are the discharge of the river, the inflow and outflow of the tide, and the littoral and surf currents and waves produced by the winds.

Tidal and discharge flow and currents must be considered together, since in their action they are united. No very accurate data are at present available as to the quantities of river and tidal flow. There are two tides daily, usually of unequal height, the higher high tide being followed by the long run out to the lower low tide. The mean tidal range at Point Adams is 7.4 feet, with maximum tides of 9.5 feet. At extreme low water the effect of the tide is perceptible to distances as great as 150 miles from the sea. The lower part of the river is a wide tidal estuary. The average rate of tidal outflow is estimated at approximately 1,200,000 cubic feet per second on mean tides of 7.4 feet and at 1,500,000 cubic feet per second on maximum tides of 9.5 feet. The maximum rate of ebb on these tides may be roughly estimated at 2,400,000 and 3,000,000 cubic feet per second, respectively. No accurate determination of the fresh-water discharge from the

Columbia River appears to be available. Estimates, based on more or less complete discharge measurements, have been made of a fresh-water discharge of from 90,000 to 120,000 cubic feet per second at low stages of the river, of 300,000 cubic feet at ordinary flood stages, and of 1,000,000 to 1,500,000 cubic feet during great freshets.

The maximum velocities of ebb currents in the channels are variable. Off Point Adams velocities of 4.5 miles per hour have been observed, and on maximum tides velocities as high as 6 miles per hour are claimed by the pilots to be attained near the end of the present jetty. Superficial observations alone indicate the existence of exceptionally strong tidal currents, and these indications are confirmed by the magnitude and conformation of the interior channels.

It is evident that the tidal flow usually predominates greatly over the fresh-water flow in volume and in the frequency with which its maximum values recur, but the latter is of great importance in any project for the improvement of the entrance. Where the fresh-water flow is negligible and there is an equality of volume between the flood and the ebb flow, it is frequently found that the maximum velocity of the ebb current materially exceeds the maximum velocity of the flood, with a corresponding increase in scour in the right direction—seaward.

The fresh-water flow for the six hours of flood tide lessens by its amount the quantity which must come in over the bar to fill the basin, and thereby decreases the capacity of the flood to carry sand into the entrance. In addition, it also fills the basin more completely and increases by its own discharge the quantity of the ebb flow from the emptying of the basin alone. From these causes there follows a preponderance of the ebb over the flood flow and an increase of ebb velocities above those that would occur with an equality of flood and ebb volumes. It is well known that the scouring and transporting powers of currents increase much more than in direct proportion to an increase in velocities. These facts place at the disposal of the engineer almost unlimited power to produce deepening at the mouth of the Columbia, and any form of contraction will deepen the channel across the bar. The best plan will be determined by questions of cost and permanence of results.

Within the gorge the direction of flow of the ebb and flood currents is determined by conditions other than any tendencies to set generally in any one direction. On the bar the set of the main channel ebb at all seasons is to the southwest at the first of the ebb and to the west southwest after the first of the ebb, attaining velocities of from  $2\frac{1}{2}$  to  $5\frac{1}{2}$  miles per hour. The set of the flood for all but summer conditions is toward the north with south to west winds, and attains velocities of  $1\frac{1}{2}$  to  $3\frac{1}{2}$  miles per hour. With south to east winds it is toward the north northwest, with the same velocities. Under summer conditions and northwest winds the set of the first of the flood is toward the south, and of the main flood is toward the south southeast with velocities of 1 to  $1\frac{1}{2}$  miles per hour. All of these bearings are from the true meridian.

The severe storms of this coast occur during the winter season, from November to April, and are known as southeasters. Beginning in the southeast they veer around to south and southwest, blowing out when they reach the northwest. These storms sometimes continue for days and are always accompanied and followed by an extremely heavy sea from the southwest. In fact these storms and seas are notorious for their heaviness and severity, and are probably equaled

or excelled in this respect on few of the world's coasts. During the winter and spring there is in some years much northeast wind. The summer wind is from the northwest and is generally a good sailing breeze, occasionally increasing to a moderate gale. The summer conditions of wind and sea are not comparable in severity to those of the winter season, and, so far as concerns the sea, they frequently degenerate into a heavy ground swell, rolling in from the west with its crest generally parallel to the coast. This swell alone is sufficient under the smoothest condition of the sea to produce incessant breakers on the outer spits where the depths are 12 feet at low water. The sea on this coast is never quiet, and the bar, when rated as "smooth" by the local pilots, is rougher than the Atlantic coast bars under average half-gale conditions.

The combined action of tide, wind, waves, surf, and, perhaps, of off-shore currents, produces the littoral currents whose existence at the Columbia River entrance is generally accepted. These currents are variable in direction and intensity but with a marked resultant set toward the north of this locality. Much cumulative evidence from the drifting of buoys and other floating material toward the north might be quoted in support of this fact but is unnecessary. Such evidence as may be found in the floor of the sea and in the form and movement of the beach and sand spits will appear later in the consideration of sand movements. While the general set of the littoral current is toward the north, it ordinarily follows the direction of the prevailing winds and is toward the south in the summer and the north during the winter. During the winter storms its intensity is claimed by pilots and others to reach as much as 2 or 3 miles per hour, or even more. The southerly current of the summer season rarely, if ever, reaches these velocities.

#### SAND MOVEMENTS.

That the fine sand about the entrance to the Columbia River is, as previously stated, readily shifted from point to point by the combined or resultant actions of winds, waves, and currents is an accepted fact. This sand movement is of the very first importance in the consideration of any project for the improvement of the entrance. The poor quality and instability in position of its bar channels can be primarily due to no other cause, and until the principles and forces governing this sand movement are thoroughly understood no project for combatting it with a view to a permanent betterment of the bar channel can be intelligently planned.

The Board has heretofore made a most careful and painstaking study of this subject in all its aspects. Its conclusions and the facts on which they are based will be stated in as few words as possible.

The movements of the beach sand up and down the coast can be determined only by their results and when considered in connection with the forces known to produce them. These results are the changes from time to time in the shoals and spits about the entrance, which indicate the resultant movement of the sand, and, by their configuration, the direction and intensity of the subsurface forces that produce them. These forces may be and have been sought to be determined by the measurement and observation of surface phenomena and such information as has been obtained from surface observations of waves and currents is confirmed by the forms and movements of the sand bodies themselves. The Board has therefore made in this connection



a careful examination of all the charted records of this entrance and an exhaustive study of the records of this bar from 1881 to 1902. Surveys or examinations have been made in every year since 1881, excepting 1884, 1887, and 1888, and the record is therefore sufficiently complete and continuous to furnish a basis for definite conclusions. It covers the time during which the jetty was under construction and the channel was improving to its best-known condition, as well as the period of subsequent deterioration to its original condition, so far as concerns the depth of the bar channel. It also includes a sufficient time previous to the commencement of jetty construction to indicate the effects of unrestrained natural forces upon the sands of the entrance. Moreover, this epoch from 1881 to 1902 covers one entire cycle of the bar channel in its swing from the south to the north with its final dissipation.

The section of most active sand movement is well recognized to be the beach and the area of shoal water and surf immediately in front of it, where the sand, beaten back upon the coast by the waves and agitated by the surf, is so placed in suspension as to be capable of transportation by the surf and other littoral currents. With the incessant waves and surf of this locality the sand of the beaches and foreshore is always in motion and, with the prevailing northerly drift of the sea currents, is moving toward the north. Under these conditions the sand of the beach or beaches south of the entrance has, in its general effect, steadily moved to the north across the entrance. This movement carries it past Point Adams in a direction approximately in prolongation of the beach itself, and forms to the north of that point the spits that, while subject to many changes of form and area, have been persistently in existence at all times. Passing Point Adams this sand drift has in the past been exposed to the dispersing effect of the ebb and flood tide currents of the entrance, and while some of it has bent toward the northwest, around the crest of the bar, the bulk has followed its original direction in prolongation of the Point Adams beach. Under the dispersing influence of waves and currents this stream of sand has been scattered to form the wide expanse of Clatsop Spit, but its prevailing direction has been shown by the persistence of the crest of the spit along its western face previous to the construction of the jetty. This crest was deflected toward the sea from a prolongation of the Point Adams beach line only so much as might be expected from the prevailing influence of the ebb currents across the spit.

Built up in this manner by continuous accretions from the south, Clatsop Spit had, so long as the drift of sand across it was uncontrolled, steadily encroached upon the channel and pushed it to the north, accompanied by a corresponding wearing away of its opposite bank. The point of greatest pressure upon the channel has been at the extremity of the spit's crest, bent inward by the influence of the flood currents from the southwest, and here has always been the gorge, the deepest and narrowest section of the entrance. The channel, or channels, when there were two, have exhibited a marked and continuous tendency to run out southwest to sea on the bar crossing. The only exceptions to this rule have been the channel shown by Admiral Vancouver's chart, of 1792 (a sketch), and deteriorating channels that have worked around to a northwesterly position. Under natural influences alone, as during the period from 1839 to 1888, the northerly movement of Clatsop Spit and the gorge of the channel, unaccompanied by a corresponding movement of the bar crossing, resulted in

an increase in channel length and an increase in the flow across the spit, followed by a lowering of the crest of the spit and the development of swash channels that may have ultimately become new south channels.

With the construction of the jetty and the stoppage of the currents across Clatsop Spit the sand flow from the south continued north undisturbed in direction, and, aided by the sand beaten up by the sea from the area of shoal water hitherto maintained by the sand carried southwest to the sea by those currents and through the south channels, has accumulated in the area protected by the jetty, establishing a new beach in prolongation of the old one, and creating near the end of the jetty a new south point to the entrance, 3 miles northwest from Point Adams. While this area was filling, the pressure on the channel at the gorge was removed and its northerly movement ceased. The wearing of the opposite north bank continued, but was exceeded by that of the south, so that the channel as a whole moved south while accommodating itself to the increased flow due to the elevation of the spit. Before the completion of the jetty, in 1895, the accumulation of sand began to overtop the work and again to encroach upon the channel, causing a resumption of the northerly movement. With the diversion of a part of this sand flow around the end of the jetty the gorge has been moved seaward to near the end of the work, and the amount of material passing over the jetty has been so reduced that the channel currents at the gorge have been able to control it. The northerly movement of the channel after 1895 was minor in extent and ceased in 1899, the midline of the channel then being still south of its 1889 position. Since 1899 this movement has ceased at all points far enough within the end of the jetty to be fully under the protection and control of that work, and at such points the channel appears, so far as may be determined from a period of three years, to have become stable in position, depth, and area. (Sec. XIX-XXVIII, pl. 40.)

The diversion of a part of the sand flow seaward toward the end of the jetty transferred the point of greatest pressure and the gorge toward that locality. The entire sand pressure upon the channel has, however, been extended over a greater length of the channel face and the increased currents have been able to control the encroaching sand without permitting any recognizable channel movement to the north. Beyond the end of the jetty the position and character of the channel are affected by other influences, but its north bank and the channel as a whole show no tendency to move to the north. The movement of both has, in fact, since 1895, been toward the south for that part of the channel within  $1\frac{1}{2}$  miles to the west of the jetty end, beyond which section there have been no continuous or well-defined limits to the channel.

The Board believes that the bulk of the prevailing drift of sand from the south has at all times traveled northwesterly over the length of Clatsop Spit to or near the gorge of the channel. Previous to the construction of the jetty it was pushed into the channel at that point and in part remained as an extension of the spit. A large part of it was, however, carried away by the strong currents that have always existed at the gorge, and together with the material scoured from the opposite north bank has been returned toward the sea by the preponderance of the ebb currents in volume and velocity. After passing the gorge these currents have always lost through dispersion their ability to transport the eroded material, and under the added opposition of the

waves have deposited it temporarily on the crest or slopes of the bar. To this deposit has been added such of the drift sand from the Point Adams beach as was pushed seaward by the currents across Clatsop Spit, and subsequently carried around the crest of the bar by the prevailing currents. That the amount of this drift sand traveling around the crest of the bar was relatively inconsiderable is evident from the records of the entrance below.

The south channel of 1868 remained practically unchanged in position until 1888, its movement being slightly to the south and east, nearer to Clatsop Spit. Previous to 1868, and since 1839, there is an incomplete record of the movement of two channels, but the shifting of the north channel was evidently due to the pressure brought upon the middle sands and the south channel by the growth of Clatsop Spit, and the entrance to the south channel retained unchanged its position from 1839 to 1888, although the gorge moved northward 3 miles in these fifty-nine years. This phenomenon also confirms the stated fact that the set of the main flood and ebb currents is in a northeasterly and southwesterly direction. Such northerly movements as occurred in channels previous to 1888 were due to the crowding of other channels south of them until, reaching the northwest quadrant of the bar, a sudden shift to the northwest occurred and a rapid deterioration followed.

The bulk of the sand that lodged on the bar came with the ebb tide from or through the gorge of the channel. To this was added such as found its way with the littoral current around the bar in deeper water or along its crest. Deposited on the crest or slopes of the bar, it has been shifted from place to place as the channels shifted in position and direction, slowly working to the north.

The construction of the jetty altered materially the conditions on the south side of the entrance. With a free path to the end of the jetty, the drift sand followed that course and built up a barrier seaward of the work. In this it was aided by the sand that had been pushed seaward by the Clatsop Spit overflow, and which, unsupported or replenished by that overflow, was beaten back upon the beach by the waves or moved along the coast by the littoral currents. The prevailing ebb currents across Clatsop Spit previous to 1889 pushed seaward a part of the drift sand that was traveling north. Little of this sand was able to find its way along the crest of the bar across the ebb and flood currents of the prevailing south-channel entrances, but, with a part of the material brought out by the ebb, was deposited off these entrances or carried to the south and beaten back upon the beach by the waves, helping to maintain the supply upon the southern beach. With the construction of the jetty and the increased flow through the gorge the channel was projected more directly westward to the sea, shifting during 1889 some 2 miles to the northwest, and leaving a sector of deep water all the way to Clatsop Spit. The 1889 location was maintained through 1890. Although the bulk of the drift sand was deposited in the jetty area, some of it, aided again by that brought out by the ebb or beaten up from the shoal area southwest of it by the sea, was carried around the crest of the bar. The straightening of the channel to the west weakened the currents across the southern bar sector and enabled its crest to build up with sand from the sources mentioned. By 1892 its projection beyond the end of the jetty and the increasing elevation of this part of the bar crest were noticeable. By 1895 its crest had attained its greatest elevation, and

the sand movement was pushing northward the bar channel, which had retained almost unchanged a due-west position during 1892, 1893, and 1894.

Between 1895 and 1896 this sand movement pushed the bar channel nearly 1 mile to the north, shoaling it 1 foot from the maximum of 31 feet in 1895, and at the same time the bar crest near the end of the jetty lost in elevation. This loss was regained in 1897, while the channel remained unchanged in depth and position. By 1897 the bar channel had swung so far north that the southwesterly set of the ebb currents was becoming ineffective in maintaining the southwesterly direction of the channel-crossing over the crest of the bar, and with the continued pressure of the sand from the south it swung markedly, in 1898, to the northwest, its history since that time being that of all such channels—loss of depth and importance when the bar-crossing is not favorably situated for gaining full advantage from the prevailing set of the ebb and flood currents.

As the bar channel moved to the north of the 1894 and 1895 positions it not only began to lose the advantage just noted, but increased in length. As a natural result of these changes and of the prevailing current tendencies, the flow across the southern and western crest of the bar increased, followed at first by a pushing of that crest seaward, and, after 1897, by a marked reduction in its elevation. This reduction in elevation of the bar crest, by increasing the dispersion of the ebb currents, still more strongly interfered with the maintenance of the channel in its northern position. By 1902 it had nearly disappeared and the bar had almost uniform depths of about 20 feet for 7 miles of its crest, with depths at two points nearly as great as remained in the old channel.

An examination of the record of this bar by a comparison of all charts since 1839, and of a full set of cross-sections prepared from the charts since 1881, convinces the Board that, as previously stated, the bulk of the sand movements about the entrance are merely the local shifting of sands, with a resultant drift to the north and an accumulation on the northwest quadrant. A merely casual examination of the charts since 1839 is a sufficient basis for this opinion, and the complete record since 1881 reinforces it. Admiral Vancouver's sketch of 1792, the only record previous to 1839, has little value in this connection, but supports the facts stated below, omitting consideration of the improbably long development of Clatsop Spit to the west shown on that sketch.

The limited projection of the bar beyond the general line of the coast is evidence that the amount of sand brought into this locality has been small compared to the existing active forces, and probably no more than those forces will be able in the future to disperse with no more than a moderate increase of the present projection of the bar into the sea and across the path of the littoral currents. In any case there has been no seaward extension of the southwest face of the bar since 1839. At a point on this southwest face somewhat more than halfway between the Point Adams shore line and an east-and-west line through the center of the entrance, the outer slope of the bar has held, with only minor variations, essentially the same position for the sixty-three years since 1839, notwithstanding the fact that during the first forty-nine years of this period the main channel and sometimes two channels have discharged into the sea across this section. During the past twelve or fifteen years the outer slope of this face has

receded with the swing of the channel to the north of it, and even with the deepening on the bar crest of this southwest sector since 1897 the recession has been only checked and not reversed into an advance. In this connection, and in conformation of the strong scouring and transporting power of the prevailing northerly currents and waves, it should be noted that all the records show the outer bar slope to have been steeper at this point than at any other.

The changes in the shape and position of the bar slopes since 1881 are shown in detail on the cross-sections accompanying this report as plates 25 to 44, the locations of the sections being shown on plate 22. These sections show no change in the outer slope of Clatsop Spit from 1881 to 1885, but a progressive deepening outside of the 18-foot contour from 1885 to 1902, without, however, any material general change in the inshore slope of Clatsop Spit beach after its formation. The outer slope of the bar from Clatsop Spit to a west-northwest line advanced between 1881 and 1885—that is, under natural conditions alone. North of this west-northwest line the outer slope remained stationary, or receded slightly during the same period. From Clatsop Spit to a south-southwest line there has been no advance since 1885, but a general recession, the outer slope being in 1902 as much as one-half or three-fourths of a mile in rear of the 1881 location.

From a SW. line entirely around the bar to Cape Disappointment the outer slope has advanced since 1889. On a WSW. line it advanced nearly one-half mile between 1885 and 1889 and receded by 1895 to the 1885 location, a position retained to the present time. North of this WSW. line the outer slope advanced seaward at each section until 1895, but at none of them has there been any material advance since the general lowering of the crest of the north sector between 1889 and 1895. There has been a slight advance in the extreme northern slope since 1895, with the continued but less-marked lowering of the corresponding bar crest between 1895 and 1899 or 1901, but the outer slope opposite and immediately to the north of the gorge has receded slightly or remained unchanged.

These changes may be summarized as follows: The advance of the outer slope of the bar that was in progress previous to 1885 on the southerly sector was checked and followed by a recession after that date to a position inshore of the 1881 slope. The swing of the bar channel in the period between and including 1889 and 1902 around nearly the entire length of the bar's crest, accompanied or preceded by the lowering of that crest throughout, produced a seaward extension of the bar and its outer slope north of the southwesterly section line (Sections I-X, pl. 33). Opposite the gorge this extension amounted to nearly three-fourths of a mile and in the northwest sector to 1 mile or more, of which in each case but little has been regained. (Pls. 25 to 32.) Opposite the gorge this seaward extension ceased even while the deep channel of 1895 still crossed the bar at this locality, the 1895 slope being slightly in rear of the 1892 line. (Sections I-VIII, pl. 31.) On the WSW. line (Sections I-IX, pl. 32) the advance of nearly one-half mile in 1889 was regained entirely by 1892 or 1895, notwithstanding a continued lowering of the bar crest to 1892, and the slope has since experienced no change in position with the variations in elevation of the bar's crest and inner slope.

It seems evident to the Board that the seaward projection of the bar since and including 1889 has been due to the pushing seaward of the sand previously deposited on the bar in the manner heretofore stated,

and that once a channel has been produced at any point the seaward growth of the bar has ceased. It is furthermore evident that the seaward extension was least on the west and southwest sectors of the bar, and that on the WSW. sector this extension was subsequently regained, the outer slope retaining there now essentially the same position as in 1885 and all the years since 1839. The force and value of these and other facts relating to sand movements will appear in the discussion hereafter of the various projects proposed for the improvement of the entrance.

While the above statements relate entirely to the prevailing northerly drift of the littoral currents and sand movements, the Board has not failed to consider the less-effective southerly currents and waves that exist under the conditions noted previously in this report. These currents and waves, to a minor extent, reverse at times the action of the preponderating northerly forces, but they do not affect the ultimate result excepting in its average rate. They have no doubt assisted in maintaining the supply of sand on the Point Adams-Tillamook Head beach and foreshore, and their effect in opposing or reversing partially the tendency of the bar to grow toward the northwest is recognized.

The Board has considered as an important part of the problem before it such data as are available regarding the volume of the sand movement. From these data and the studies made by the Board (pls. 45, 46, and 47), it appears that there was between 1885 and 1895 an increase in the volume of sand about the entrance, a deposit taking place on Clatsop Spit on the southwestern bar sector and in Bakers Bay and a lesser scour at other points. This movement during the period of jetty construction and of disturbance of normal conditions is of small importance compared with the results since 1895 and the establishment of the bar in its present position. The studies just mentioned show since 1895 a decrease in the volume of sand about the entrance and outside of a line joining Point Adams and Cape Disappointment. While there have been large movements of sand in this area since 1895, the movements have been almost entirely of local character, with a positive decrease in volume. The deterioration of the bar channel has been due not to any increase in the quantity of sand about the bar, but to local sand movements and to insufficient control of ebb and flood currents and of the northerly sand movement across the entrance.

It has been already stated that the Board believes the natural forces at this entrance to be sufficiently powerful to prevent, with suitably located structures, any material and permanent advance of the bar westward in opposition to the waves and across the path of the prevailing northerly currents. This opinion is based upon several observed facts, not the least important of which is the constancy or diminution in the volume of sand upon the bar proper regardless of the drift of sand from the south and the additions discharged by the river. It may be repeated here that these additions from the river are relatively small and the supply of drift sand comparatively limited. The beaches south of Tillamook Head are not of first importance and the indications from the general coast map (U. S. Coast and Geodetic Survey, No. 6100) point to a small movement around that head and those to the south of it. Information has also been furnished to the effect that the beach south of Point Adams is receding, particularly at its southern end. Assuming to be correct this information, which is not based on surveys, it may be concluded that with the closing of

the southern channels and the cutting off of the sand supplied by them to replenish the volume of the south beach, the supply from the south around Tillamook Head is insufficient to maintain that beach and its foreshore as in the past, and that the deepening noted in front of Clatsop Spit beach continues as far south as Tillamook Head. In this case, with the loss to the beach of a part of the supply that maintained it, the northerly drift across the entrance should be less in volume in the future than in the past.

#### THE 1885-1895 JETTY.

The existing works for the improvement of the mouth of the Columbia River were carried out upon the recommendations of a Board of Engineers convened in 1882, under authority of the act of August 2, 1882. The report of this Board was printed in Senate Executive Document No. 13, Forty-seventh Congress, second session, and in the Annual Report of the Chief of Engineers for 1883, pages 2011-2037. After a consideration of all the available data relating to the location and depths of channels across the bar at the mouth of the river previous to and at the time of its action, this Board made the following remarks and recommendations:

\* \* \* \* \*

The problem before the Board is to present a suitable project for improvement of the mouth of the river as we now find it.

It is evident that the depth of water in the channels would be increased if the wide opening between Cape Disappointment and Point Adams were suitably diminished. Some idea of the proper measure of this diminution may be obtained from an examination of a section of the river near its mouth, where there has always been, as far as known, a sufficient depth of channel. Such a section is found between Chinook Point and Point Adams.

If the waterway between Cape Disappointment and Point Adams be narrowed to something less than that between Chinook Point and Point Adams and the volume of water be properly directed, we may reasonably expect as good a channel to be the result.

It may be supposed the best way to accomplish the object stated above would be to place a structure on the bar, leaving an opening between it and Cape Disappointment or Point Adams or openings at both places. It is believed the construction of such a work would be impracticable. If practicable, the expense would be enormous.

A more satisfactory method of obtaining the desired result presents itself. This is to build a single jetty from Point Adams so as to make the distance between its outer end and Cape Disappointment nearly the same as that between Chinook Point and Point Adams, and inasmuch as at the section between Cape Disappointment and the proposed jetty the wave action is very potent and does not exist at the Chinook section, it is thought best to make the new mouth of the river narrower than the present Chinook section.

\* \* \* \* \*

In any work of this character great care should be taken that the action of any structures placed in the river be not too violent; otherwise harm and not good may be done by them. The great agent to make the channel over the bar deep and maintain it is the tide. This has an ample force and volume, but its action requires regulation and direction to the important point. The jetty intended for the improvement of the channel over the bar should be so arranged in plan and in height as not to obstruct unduly the free entry of the flood tide into the basin near the mouth of the river from which it is to ebb and do the work required of it. The artificial structure should also have such a position as to force the whole volume of the ebb toward a limited area of the bar through a single channel and not to have it spread out and its power expended over too large a space and through several channels.

The plan proposed by the Board is based on these ideas. The structure is kept down to the level of low water, and therefore does not materially obstruct the inflow of the flood tide. It regulates and directs the whole volume of the ebb below the level of low water.

The Board recommends the construction at as early a day as possible of a jetty slightly convex to the north, extending from the shore near Fort Stevens in a northwesterly direction toward a point about 8 miles south of Cape Disappointment, this jetty to stop short of that point or be prolonged beyond it as experience may indicate to be necessary. Its location is shown on the chart herewith of the engineer hydrography of 1881 and 1882.

It is impossible to state in advance exactly the width that the work should give to the channel at Cape Disappointment to secure deep water on the new bar outside. That the maintenance of the works may be practicable it certainly must not be too small. Three miles have been taken, which will be somewhat reduced by the continued existence in a modified form of Peacock spit. A certain latitude in the amount of contraction is very desirable. Should that adopted be too small it can be increased, either by raising the jetty somewhat or by a short jetty on Peacock spit.

\* \* \* \* \*

The jetty is intended to be brought up to the level of low water.

It is estimated that of this jetty 5,000 linear feet may be built in water of 6 feet depth or less at low water; 7,500 in water between 6 and 11 feet; 4,000 in water between 11 and 16 feet; 7,500 in water between 16 and 21 feet, and that the last 7,500 feet will need the facing of heavy beton blocks. The facing of this last 7,500 feet is expected to add 25 per cent to what its cost would be if not so protected. The prices below are on a basis of \$5 per cubic yard of the whole mass in place.

5,000 linear feet, at \$45 .....	\$225,000
7,500 linear feet, at \$80 .....	600,000
4,000 linear feet, at \$140 .....	560,000
7,500 linear feet, at \$310 .....	2,325,000

Total .....	3,710,000
-------------	-----------

The position is one of very great exposure and the allowance for contingencies should be large, probably not less than 50 per cent. If this margin be accepted, the total estimate amounts in round numbers to \$5,500,000.

\* \* \* \* \*

The work proposed transfers, in effect, the river section now existing at Chinook Point, with depths of 40 feet, to Cape Disappointment, 6 miles farther seaward. Judging from the present form of the river mouth, this will throw the sea bar seaward of the present one, with deep water on it. If the work is built and it causes a deep channel to be cut across the sand cordon, it must yet be expected that ultimately a new sand cordon will be formed far to seaward of its end; but considering either the slight projection to be noticed in the present 100-foot curve opposite the mouth of the river or from the small amount of sediment in the river as compared with great sediment-bearing rivers, such an event seems too remote to enable even a guess to be made as to its date.

\* \* \* \* \*

It is the opinion of the majority that the work proposed should be brought only to the level of low tide. If, however, experience should demonstrate the necessity for raising the jetty to any level greater than that of low water, it can be readily done on the lower jetty as a foundation. It should be observed, however, that the violence of the waves will be more severely felt and the difficulty of maintaining any work be increased as its height is the greater.

The Board realizes and has already called attention to the exposure of the position and the difficulty to be expected in building the jetty, especially its outer part; but it is to be observed that the head of the jetty will be partly covered by the middle sands, and be thus sheltered from the most severe wave action.

\* \* \* \* \*

The Board has also considered the propriety of raising the jetty to midtide, and the opinion of the majority is that it should be kept at first to the level of low water. The reasons for this conclusion are the following, which have been adverted to in another part of the report: A work brought up to low water will be quite effective in directing the ebb tide, while it would interfere much less with the inflow of the flood tide. The exposure to waves and the consequent difficulty and cost of construction will both be considerably less if the lower height of the jetty proves to be sufficient. If this height be too little it can be increased.

The object sought to be gained by the Board was the concentration of the river into one channel and its discharge as a unit to the sea



by so elevating Clatsop Spit as to restore it to approximately the condition that existed at such times as the channel had its best depths and location. The Board was unanimous as to the general methods to be followed to obtain this end, but one member preferred a jetty raised to the level of midtide and located on a line running more northerly in the shoaler water on the channel side of the spit.

Work was commenced in 1885 upon the jetty recommended by the majority of the Board. By 1893 the jetty had been extended on the line recommended by the Board to a length of  $4\frac{1}{2}$  miles from the point at Point Adams that was regarded as its root or shore end, and had been raised to elevations above datum varying from 2 feet at the outer end to 7 feet at the shore end. Its outer end was distant about 3 miles from Cape Disappointment and one-half mile east of a north and south line through the Cape light. In 1893 a second Board of Engineers was convened to consider the question of completing the work. In its report (Annual Report, Chief of Engineers, 1893, pp. 3499-3503), this Board remarks and recommends as follows:

\* \* \* \* \*

It is evident at once that since the commencement of the construction of the jetty great changes have taken place to the benefit of navigation in the shape and position of sand bars and spits in and about the mouth of the river. The great middle sands directly in the mouth of the river have been removed by the erosive action of the water, leaving a straight out-and-in channel for deep-draft vessels, with a depth of 30 feet at low water. The old north and south channels are closed. The changes on Clatsop Spit are all favorable to the stability of the jetty. Over the area between the jetty and the 24-foot curve on the north side, averaging in width about one-half mile, there has been an average fill of 4.4 feet. North of the 24-foot curve erosion has taken place to about the same extent. The fill has been greatest near the jetty. Extreme low water shows a strip of bare sand on the north side from a point about 1 mile from the root of the jetty to near the outer end.

On the south side of the jetty there has been a large accumulation of sand. Within the area formed by the Point Adams shore the jetty and a line drawn from the outer end of the jetty to the shore, about  $1\frac{1}{2}$  miles south of the Point Adams light, comprising about 8,000 acres, there has been an average deposit of 5 feet. A large portion of this area is now bare at low water, and some portions even at a 3-foot stage of the tide.

The jetty offering a resistance to the waves and currents checks the sand in its passage across the spit and causes it to accumulate on both sides. The accumulations spread out at a considerable distance from the jetty cause the heavy waves to break and lose a large part of their force before reaching it. So long as this accumulation process can be maintained and the higher the accumulations can be raised the better will be the results of the work.

It has been observed during the progress of its construction that there are certain localities where the tide rushes across the line of the jetty with great velocity, while it is above the level of the rock at those places. As a consequence the sand does not accumulate here to the height desired and the jetty is in constant danger. At these places rock was piled in to counteract these cross currents until it reached the level of high tide. This effect was more noticeable in the first mile and a half of the jetty than elsewhere. Trouble was also experienced here with heavy drift that came down the Columbia, lodged against the tramway and was thrown violently against the piles by the waves. This difficulty was obviated as the height of the rock was increased. For a distance of about 300 feet back from the outer end of the jetty the mattresses at the base were widened to 70 feet and the rock raised to 4 feet above datum. This has settled to about 2 feet and seems firm.

The parts of the jetty that are now exposed to the heaviest swells from the sea are the outer 2,000 feet and the 2,000 feet near the root. This latter stretch is severely tried by long rollers coming from the northwest during and after storms. Before the construction of the jetty these swells spread out over and expended their force gradually upon Clatsop Spit. Now they are confined on one flank by the jetty, which offers a resistance to this force. There is noticeable a gradual shoaling in the water to the northward of the jetty in this locality since its construction. As this process continues the waves will be more and more broken up

before they reach the jetty. At present the reflex of the waves has left a narrow space along the north side, where the water is deeper than it is farther away. A racing of the waves to a limited extent also takes place along this side of the jetty.

There can be no doubt that the jetty as it now stands has accomplished one of the two great objects for which it was constructed, viz, by concentrating the waters that pass in and out over the Columbia River bar to make a navigable channel over that bar, having a depth of 30 feet at low water. The other is to maintain that channel depth. The jetty is a long, thin, narrow backbone of solid material, resting upon a very doubtful foundation, against which the forces in action at the locality have accumulated large quantities of the shifting sands. These in turn have been able to break the force of the waves and protect the jetty from destruction. Its safety and the permanence of the present favorable condition of channel over the bar depend upon the amount of this sand that can be accumulated. It is evident to the Board that the raising of the jetty above the level of mean low water, which has already been done, has been followed by beneficial results. The currents have been prevented from washing away the sands in the vicinity of the jetty, and have been more largely directed to where they will produce desired results. If this process be continued, there is every reason to believe, judging from observed facts in this case, that there will be increased accumulations of sands on both sides of the jetty which will add greatly to safety.

To give greater permanence to the sand and to increase the quantity that may accumulate in the vicinity on the north side of the jetty, which would seem to be the direction from which danger is most likely to come, the Board recommends that four low groins be built out from the main jetty—one near station 52+00, 1,000 feet long; another near station 88+00, 1,000 feet long; another near station 151+00, 600 feet long, and the fourth near station 288+00, 500 feet long. All to slope on the top from datum level at the jetty to the bottom of the river at the outer end. The rock to rest upon brush mattresses about 2½ feet thick and 40 feet wide.

With regard to the jetty itself, the Board recommends that when considered as completed the top at the shore-end station 25+80 should be at reference 12 above datum plane, and should slope thence to reference 10 out to station 122+00 (1.8 miles), thence to reference 4 at the outer end. The rock necessary to raise the jetty to this height to be dumped upon the present pile, letting it take what slope it will in cross section under the action of the waves.

The recommendations of the Board were, in effect, that the height of the jetty should be increased at the shore end to 12 feet above the mean level of the lower low waters, sloping thence to 10 feet above this datum in a distance of 1.8 miles and to 4 feet at the outer end. Four groins or spurs were recommended to be constructed on the channel side of the jetty to accelerate the accumulation of sand and to thus add to its stability. The estimated cost of this work, in addition to funds on hand and available, was \$338,180, making the total estimated cost for completion \$2,025,680. The Board confined its attention to increasing the stability of the jetty through the encouragement of sand deposits on both sides of it, and by failing to recommend any increase in the length of the jetty, indicated by inference its opinion that no additional extension seaward was necessary at that time.

From the commencement of jetty construction in 1885 the work proceeded slowly until the summer of 1889, when more liberal appropriations permitted of a rapid extension of the work. During that season the jetty was pushed forward 1½ miles to a distance of 3¼ miles from the shore end, and had been raised to or near low water throughout the greater part of its entire length. Between 1885 and 1889 there occurred no material change in the bar channel, but with the rapid work of 1889 and the reduction of flow across Clatsop Spit the effect of the jetty upon the bar was immediately noticeable. The channel on the bar swung around to the west-southwest in 1889 and deepened to 30 feet by 1893, the movement to the north continuing but at a slower rate than in 1889. Its subsequent history has been already given and need not be repeated here.

The jetty was completed on or before June 30, 1896, in accordance with the project of 1882, and the modifications recommended by the Board of 1893. It had cost \$1,958,602.09 instead of \$3,710,000, or \$5,500,000 as estimated by the Board of 1882, and the work at that time appeared to have been entirely successful in that it had, at an expense much less than the estimate, produced the result contemplated in the project, a channel running straight out to sea and 30 feet in depth across the bar.

The Board of 1882 recommended the construction of a low-tide jetty, extending from Point Adams northwesterly to a point about 3 miles south of Cape Disappointment. In an improvement of this magnitude it was impossible to provide accurately in advance for all the works necessary to produce and maintain the desired channel or for the exact dimensions of those recommended for immediate construction. In its project the Board therefore wisely left much latitude for variations in details, and provided for such additional length and height of the proposed jetty as circumstances might subsequently indicate to be necessary, as well as for the construction of a north jetty across Peacock Spit, should contraction be required above that resulting from the south jetty alone.

After a due and careful consideration of all the circumstances and of the results secured by the works constructed under the 1882 project, so far as that project has been carried out, the present Board can devise no project that is better than that recommended by the Board of 1882, or in which the works constructed under the 1882 project, the existing jetty would not form a necessary part, substantially the same in location and construction and modified in their extension only so far as may be necessary to secure a 40-foot channel in lieu of the 30 feet of the original project.

#### PROJECTS.

The problem before the Board is to secure and maintain at the Columbia River entrance a channel 40 feet deep at the lowest low water. Many suggestions have been made as to the methods best suited to produce the desired results, and several projects and propositions have been formerly placed before the Board. Due consideration has been given to them all, but only those appearing below will be discussed in detail.

The projects before the Board have included permanent works and temporary expedients. Several methods for temporarily increasing the depth on the bar have been suggested to the Board, but none seemed worthy of consideration excepting the modern sea-going dredge.

#### DREDGING.

The rapid deterioration in the controlling depth in the bar channel after 1898, and its ultimate decrease to 22 feet in 1902, has placed a great burden upon the shipping interests of the Columbia River. In rough weather, with heavy seas and a turbulent bar, a ship should have under her keel a depth at least equal to the mean rise of the tide, and at times it is estimated that this margin should for safety be increased to 10 or 12 feet in order to provide for the "send" of a ship in a heavy sea. The full low-water depth on the bar is therefore available only at high tide and with a "smooth" bar. During the winter season of severe storms and heavy seas—the period also of

heaviest shipments—this depth is seldom available even at high water. The decrease in the bar depth to 24 feet and then to 22 feet has consequently been a heavy tax upon the shipping of the port, causing many and long delays to both inbound and outbound vessels. It has also caused vessels to resort to other ports for the completion at an increased expense of cargoes after loading here to as great a draft as bar conditions would permit, or has diverted them entirely from this harbor.

These circumstances have brought about an urgent and just demand for immediate relief, and the Board has recognized the necessity for such action as will most speedily lead to an increased depth on the bar, pending the carrying out of such plans as might be ultimately adopted for its permanent betterment. This necessity brought the Board to consider the question of dredging as a means of at least temporary relief, only to be confronted with the fact that no suitable dredge was available or could be built inside of eighteen months. It, however, came to the knowledge of the Board that a ship suitable for conversion into a satisfactory dredge might be obtained from among the army transports engaged in the Pacific Ocean service, and a preliminary report was submitted, with a recommendation that such a ship be obtained by transfer if possible, and converted into a dredge with the least practicable delay.

In accordance with this recommendation, and with the approval of the Secretary of War, arrangements were completed in October, 1902, for the transfer of the U. S. army transport *Grant* to this work, and measures for her conversion into a dredge were promptly undertaken. It is believed that this work is now under contract, with a reasonable prospect that the dredge will be ready for service at as early a date as weather conditions will permit of her beginning regular work; that is, by the 1st of June, 1903.

The Board considers the use of a dredge on this bar to be somewhat experimental. There are reasonable differences of opinion among those familiar with ocean bar dredging as to whether any dredge can be operated on this notoriously rough bar with sufficient regularity and continuity to produce any large useful result and to justify the expense of her construction and maintenance. Suitable dredges have, however, been operated on other very rough bars, and the opinion of many who are most familiar with this entrance is that a dredge of large hull dimensions (the *Grant* is 445 feet long and of 5,590 gross tonnage) will be able to render satisfactory service.

The Board also considers it possible that such a dredge may be of permanent value at this entrance should weather conditions be found by experience to permit of her regular operation, and the bearing of this experience upon the execution of the plans hereafter recommended for the permanent improvement of the bar channel will be important. Experience with seagoing suction dredges at many other exposed entrances has been satisfactory. During the progress of the jetty work herein recommended it may transpire that the dredge in connection with this part of the work may be able to maintain an entrance channel 40 feet deep and half a mile wide. If so, the jetty work recommended may not have to be carried to completion. In any case, there is much useful work on the Pacific coast that can be performed by a dredge of this character and the lack of a seagoing dredge of Government ownership has, as in the present case, been severely felt on that coast. Even should it be determined by experience that dredging can not be satisfactorily done on the Columbia

River bar, no loss will therefore be suffered by the Government or by the funds appropriated for this particular improvement.

\* \* \* \* \*

#### THE 1899 PROJECT.

In accordance with the requirements of the act of March 3, 1899, the officer in charge of the work, Maj. W. C. Langfitt, Corps of Engineers submitted a project for "obtaining a channel of 40 feet depth at lowest low water." This project is contained in his report of November 6, 1899, as printed in House Document No. 94, Fifty-sixth Congress, first session, and reprinted in the Annual Report of the Chief of Engineers, United States Army, for 1900, pages 4430-4453.

Major Langfitt's project proposes a 3-mile extension of the existing structure, the outer end being carried well out to the crest of the bar. This extension is convex to the channel and its proposed outer end is but little north of an east and west line through the end of the old jetty.

This project is so nearly in accord with the Board's own plan that it will not be discussed here, but in connection with that plan below.

#### PROJECT PROPOSED BY THE BOARD.

After a full and careful consideration of all the data, information, and projects before it the Board recommends the following project for the permanent improvement of the entrance to the Columbia River. The locations of the works proposed are shown on the accompanying map, plate 21.

The existing jetty, hereafter called the south jetty, should be extended due west for a distance of  $2\frac{1}{2}$  miles unless impracticable depths, as hereafter noted, are encountered before that length of jetty has been constructed. This work should be pushed seaward as rapidly as practicable, with the use at first of only so much stone as may be necessary to secure the construction trestle against destruction by the sea, but this limitation is not intended to interfere with raising the level of the work when stone is available in excess of that required for extensions. The jetty should subsequently be brought up to the level of mean lower low water throughout. As soon as the accumulation of sand and the consequent reduction of the effect of the sea upon the jetty will permit of its being done with such stone as is available for the work the old and new portions of the jetty should be raised to mid-tide level. The Board can not foresee either the necessity of raising this work to or above the level of high water or the practicability of so doing at a reasonable cost, and consequently no provision is made therefor. The desirability of so raising the height of the jetty as to increase the accumulation of sand and thereby afford greater protection to the work itself under extraordinary storm conditions is, however, evident, and the question is left for determination at such time as it may appear practicable. The Board has also considered the construction of groins to aid in the accumulation of sand and thereby increase the security of the jetty. Their construction on one or both sides of the jetty at such points as may at the time appear most suitable is recommended whenever their necessity becomes evident.

To produce a bar depth of 40 feet and a channel of suitable width, not less than one-half mile, and to maintain it permanently will, in

the opinion of the Board, require a nearly complete control of the ebb flow across the bar. The beneficial results following from such control are seen at the present gorge, just within the end of the existing jetty, where great depths are found, and a depth of 40 feet is projected seaward  $1\frac{1}{2}$  miles beyond the end of the controlling work. With the extension of the south jetty the north bank of the channel will undoubtedly grow seaward and increase in height. Should the growth of this bank in length and elevation be sufficient to give the necessary control of the ebb flow, no works in addition to the south jetty will be required. The Board is, however, not satisfied that this will be the case. It therefore recommends the construction of a north jetty at such time as its necessity becomes apparent, and in case the south jetty alone fails to produce or maintain a permanent 40-foot channel. This north jetty should start from the most suitable place on Cape Disappointment south of Mackenzie Head and run in a generally southwesterly direction across Peacock Spit, following approximately the line of least depths, but so located that if necessary it may be without abrupt change of direction ultimately extended to a point about 2 miles north of a point  $2\frac{1}{2}$  miles due west of the present end of the south jetty. The order and method of construction for the north jetty should be the same as that prescribed for the south jetty, excepting that the raising of the inshore end of the north jetty to low tide and then to mid tide may, in the discretion of the constructing engineer, be deferred until after the completion of its outer section, where greater results in controlling the currents are to be expected from equal amounts of work.

It is possible that before the south jetty can be extended to the length specified there may be such a change in the form of the bar as to carry the work into depths where advantageous and economical construction may be impracticable. The Board sees no good reason to expect the occurrence of such a contingency and does not believe it will happen. It appears, nevertheless, wise to provide for it. The extension of the south jetty should be first completed, but should it become impracticable for the reasons just stated to carry this extension to the full prescribed length, then the construction of the north jetty should be commenced. The outer end of the north jetty should be kept in rear of the outer end of the south jetty, unless it becomes absolutely necessary to extend it in advance of the latter to obtain the desired results during a suspension of work on and pending the completion of the south jetty. The ultimate full length contemplated for the north jetty is  $2\frac{1}{2}$  miles. It may be stopped short of that length at any time if such a length appear to be not necessary.

To obtain the channel improvement desired at this entrance it is self-evident that the flow must be concentrated within one channel of moderate width and discharged as a unit to the sea. Moreover, this concentration must extend to the sea, and if the best, most economical, and most permanent results are to be obtained it must be so directed as to gain the maximum benefit from the forces at hand and as to avoid, so far as is possible, a recurrence of existing conditions. In other words, the concentration must include all the flow or so much of it as may be necessary to give the desired channel depth and width; it must be extended and maintained across the bar so that no dispersion may take place until after its work is done, and it must be so directed that, while securing the desired improvement, the bar shall be pushed the minimum distance seaward by reason of its action.

After a consideration of all known local circumstances and conditions in connection with the well-established theories upon which such improvements are based the Board believes that these aims will be most nearly attained by the works which it proposes, and which will give a sufficient concentration so directed as to take advantage of the prevailing direction of the ebb and flood currents, and as at the same time to locate the channel upon the sector of the bar that has maintained its position practically unchanged during the vicissitudes of the past sixty years.

The entire ebb flow of the entrance now passes through the gorge at the present end of the south jetty, with the exception of the small amount that finds its way through Bakers Bay and thence to the sea close to Cape Disappointment. Passing the gorge the ebb is no longer controlled on the south, and with the strong prevailing tendency of the ebb to set toward the south the waste of its flow in that direction is marked. In the past it has held the southern crest of the bar to a low level, notwithstanding the drift of sand from that direction. If sufficient contraction is to be obtained it is evident that the southerly set of the ebb and its consequent dissipation of energy must be controlled until the proper point is reached for directing it upon the bar. At the same time by building squarely across this section of most active overflow the maximum concentrating effect for a given length of jetty is obtained.

The area of the discharge section located along the crest of the bar is about 850,000 square feet at mean lower low water, and of this section a low-tide extension of the south jetty on the Board's plan,  $2\frac{1}{2}$  miles long, will cut off nearly 300,000 square feet. Its effect in deepening the bar channel can not be doubted, and the Board believes that the south-jetty extension alone will produce a channel depth on the bar much in excess of the 30 feet temporarily resulting from the old work. The Board, however, is not assured that a low-tide or mid-tide south jetty alone will be sufficient to secure and permanently maintain a 40-foot channel. Greater concentration may be had from a jetty brought to or above the level of high tide, but the difficulties to be expected in constructing and maintaining such a work, unless the costly method of very large concrete blocks be used, have already been commented upon in this report.

The Board has therefore recommended that such additional concentration as may be required above that obtained by a mid-tide extension of the south jetty shall be secured by a north jetty of similar design and construction, so located that the two jetties will concentrate upon the bar all of the flow below the level of mid tide.

The height to which a jetty should be built has been a matter of serious consideration in this as in all similar works. The present jetty, raised at first only to the level of low tide, was finally built to a height of 10 feet above datum (mean lower low water) for  $1\frac{1}{2}$  miles from shore, sloping thence to a height of 4 feet at its outer end, which was thus practically at mid tide. This mid-tide height at the outer end was not long maintained, as the seas have flattened it down, and the outer five-eighths of a mile is now at or just below datum. It rises in the next seven-eighths of a mile to its height as constructed and maintains it thence to the shore end. The difficulty of maintaining the full height of a mid-tide or high-tide structure where exposed to the sea and without the protection of surrounding sand accumulations has been made evident by the experience of the present work. The

Board believes that a low or mid-tide jetty built upon the line recommended can be maintained under the protection of the sand that will be held by it, but that the maintenance of a high-tide jetty is uncertain and very doubtful unless the method of costly construction with a superstructure of heavy concrete blocks is employed. Such expensive construction is not justifiable when the desired results can be better and more economically secured by another method.

The construction of a north jetty, should the south jetty alone fail to secure the projected channel depth of 40 feet, will undoubtedly give better results than the raising of the south jetty from mid tide to high tide and at a cost less than that of a concrete superstructure for the latter. The northern bar section and Peacock Spit have always furnished across their crests an overflow section of large area, although not so injurious in effects as the waste to the south. A north jetty on the Board's plan will cut off 200,000 square feet or more of the existing section over the crest of the bar, and under the conditions of depth that now exist and that are probable in the future will be of moderate cost.

Moreover, the two jetties will, with a certainty that admits of no questioning, concentrate all of the mid-tide flow into one channel and direct it upon the bar at the point selected as most suitable for the bar crossing. They will at the same time secure the permanence in location that is necessary for the maintenance of the best depth and that, by its absence in the past, has been fatal to permanently good results.

The effect of a satisfactory concentration of the ebb flow is seen at the present gorge, just within the end of the old jetty. The depths at that point are continued seaward so that a 40-foot channel, about one-half mile wide, is maintained to a distance of  $1\frac{1}{4}$  miles beyond the end of the jetty. By prolonging the concentration seaward  $2\frac{1}{2}$  miles, this 40-foot channel will be projected across the bar and to deep water beyond.

The concentrating and directing effect of the old jetty is due not to the work directly but to the sands accumulated under its influence. With the extension of the south jetty the sand deposit upon Clatsop Spit will also be extended seaward upon both sides of the enrockment, and, as in the case of the old work, these sand spits will be the actual directing and controlling banks of the channel. It is not to be expected or desired that the jetty or jetties themselves shall act as training walls, and with the shifting character of the sands of this entrance it is doubtful if they could be compelled to do so were the attempt made. Subjected as they are to the leveling influences of the heavy seas of this coast, the stability of jetties of moderate cost, is only too precarious under the most favorable conditions of design and the additional risk of undermining that would follow from their use as training walls is unwise if it is avoidable. The use of numerous small groins to build up with sand the area on both sides of the jetties is therefore recommended should they be needed.

Under the circumstances and for the reasons just noted the locations of the works proposed by the Board may be varied within reasonable limits without affecting the predicted results provided their outer ends reach the points selected. In this respect they in no wise differ from the old work, whose precise location under the same restriction might have been varied materially with no change in the result. The sand accumulating about the jetties will, excepting at their outer ends,



reach their tops, and encroaching on the channel will act as its directrixes subject to the maintenance of an equilibrium of all the forces concerned. This condition of stability in a deep channel with strong currents running between banks of sand now exists at and near the present gorge and under the proposed project will be extended to the sea.

The width of 2 miles proposed by the Board at the outer ends of the jetties is based upon the above conditions. An actual channel width of over 1 mile, with very deep water (85 feet) and steep side slopes, exists at the gorge, and the safety of the jetties against undermining requires that the distance between them shall be considerably in excess of the effective width at the present gorge. In any case the actual potential width of the channel between the new works will be and is desired to be determined by the equilibrium established between the sand and currents, as at the present gorge, where a width of but 1 mile is maintained through banks of sand although the opening between the fixed points of the entrance is 3 miles in width.

The ebb currents of this entrance are unusually powerful and their predominance over the flood is marked. The basin fills slowly through two tidal oscillations, the lower low tide being followed by the lower high tide, the higher low tide, and the higher high tide. Following the latter comes the long run out from the highest tidal stage of the day to the lowest in about the same time interval and with consequently strong currents aided by the fresh-water discharge. The power of these currents is evident when proper control is exercised, and excessive concentration is as unnecessary as it is dangerous.

The best location for the crossing of the channel over the crest of the bar is determined by two influences, the prevailing set of the tidal currents and the reduction of bar advance to a minimum. At the mouth of the Columbia they both indicate the best location of the bar channel as being south of an east and west line through the gorge.

All available evidence from surface observations and the study of sand and channel movements shows the prevailing set of the ebb currents to be to the southwest. This evidence has already been stated in detail. The channel or channels in the period before 1889 and since 1839 persistently crossed the bar toward the south and southwest. This was the case with the so-called north channels of 1839, 1841, 1850, 1852, and 1868. Before and after the completion of the jetty in 1895 the channel across the bar also persistently pointed to the south of west even when as in 1896-97 it was 1 mile north of an east and west line through the gorge. A change to the north of west was followed after 1898-99, as it was about 1880, by a rapid deterioration and disappearance of the channel, the maintaining influence of the southerly set of the ebb currents having been lost.

The best channels have always run toward the southwest or south of west on the bar crossing, and the 1895-1897 channels, which had the greatest depths known, crossed the bar toward the southwest, although they ran west and north of west from the gorge to the bar. Any plan for the improvement of the bar should take advantage of the prevailing set of the currents, so well established by observation and from the history of the bar. The Board's plan while concentrating the flow into one channel and directing it along the same course as when the channel was at its best—1895—will also permit it to flow to the southwest across the bar in accordance with the well-defined set of the currents at the same location and in the same manner as in 1895.

At this point the projection of the bar seaward under the influence of the work and on account of the redeposit of the sand scoured in deepening of the channel will be the least. The outer slope of the bar at the point selected by the Board for the location of the bar channel retains now practically unchanged the same position as it did in 1839. It has advanced but slightly from time to time with radical changes in the bar channels and this advance has been temporary and much less than at any point north of this location. Moreover such advances have been subsequently reversed and, as in 1892-1895, have even ceased or been reversed while a deep channel still existed at this location. The Board can not expect that an advance of the bar at this point will not follow the construction of the jetties and the removal of the large quantity of sand necessary to secure a 40-foot channel. Such advances have invariably been found at all jetty harbors. The experience of the past is, however, the best evidence that the bar advance will here be a minimum and much less than to the north. The waves and strong littoral currents have at this point their maximum effect in retarding and counteracting bar advance, and unless the history of the last sixty years is misleading, that advance will be speedily checked and probably reversed, with a return of the outer bar slope toward its present location.

The Board considers the location of the channel in the northwest sector of the bar as inadmissible for the reasons stated. A location to the south of that recommended would have many advantages. Such a location would, however, by shortening the south jetty reduce the amount of concentration afforded by it and correspondingly increase that required of the north jetty if the total concentration is maintained. No great increase in the concentration afforded by the north jetty can be had without a material shifting of its outer end toward the south of the Board's location. Such a movement of this outer end will place it across the strong ebb currents projected westward from the gorge as well as across the paths of the present channel and of the best channels of the past ten years inside the bar, and the Board deems it unwise on this bar to so place the jetty structures built upon banks of easily eroded sand and subjected to violent wave actions.

#### ESTIMATES.

In preparing its estimates of the cost of the works proposed the Board has been guided largely by the experience gained in the construction of the old work and the recommendations of the resident engineer who has had fourteen years' continuous connection with the work on this bar.

The jetties are proposed to be of random stone of the same character and placed in the manner as in the old work. The cross sections adopted are those also of the old work, increased to meet the greater exposure of the new works and the leveling action of the sea. In the old work the enrockment assumed slopes that averaged somewhat less than 2 on 2½ and with stone weighing 167 pounds per cubic foot. The weight of the stone per cubic foot of the jetty was 107 pounds. This latter weight has been retained in these estimates but the side slopes have been assumed to be 2 on 3. In addition to this increase of cross section over that of the old work, a horizontal increase of 15 per cent in the calculated quantities of stone has been made to provide for scour in advance of the work and for the leveling action of the sea.

This 15 per cent increase in calculated quantities, together with the final 20 per cent allowed for engineering, superintendence, and contingencies, makes a total increase of 38 per cent to provide for the changes in conditions that can not now be foreseen and for the maintenance of the work until it becomes self-sustaining. While this total allowance may seem large, the Board deems it no more than sufficient for safe estimates when the great exposure and uncertainties of the locality are considered in connection with the length of time that will probably be required for its execution.

The unit price adopted for stone in place is \$1.16 per ton of 2,000 pounds, or \$1.68 per cubic yard of enrockment, and for the construction of trestle is \$7.50 per linear foot of double-track tramway, excepting for the shore trestle of the north jetty.

No estimate has been made for a mattress foundation. The usefulness of such a foundation is at least doubtful, and the difficulties and delays to be experienced in placing it under the conditions existing in this work will outweigh any probable advantages resulting therefrom. In any case the constructing engineer may use mattresses should he find them desirable, and such use will not increase the total cost of the work.

The following estimates have been made by half-mile lengths of the work and include the cost of raising the outer end of the old work and all of the new work to the level of midtide:

*South jetty.*

Raising old jetty:		
2,000 feet of tramway, at \$6.50 .....	\$13,000	
100,000 tons of stone, at \$1.16 .....	116,000	
		\$129,000
Extension of jetty:		
First half mile—		
2,640 feet of tramway, at \$7.50 .....	19,800	
333,500 tons of stone, at \$1.16 .....	386,860	
		406,660
Second half mile—		
2,640 feet of tramway, at \$7.50 .....	19,800	
315,000 tons of stone, at \$1.16 .....	365,400	
		385,200
Third half mile—		
2,640 feet of tramway, at \$7.50 .....	19,800	
296,700 tons of stone, at \$1.16 .....	344,172	
		363,972
Fourth half mile—		
2,640 feet of tramway, at \$7.50 .....	19,800	
248,400 tons of stone, at \$1.16 .....	288,144	
		307,944
Fifth half mile—		
2,640 feet of tramway, at \$7.50 .....	19,800	
233,450 tons of stone, at \$1.16 .....	270,802	
		290,602
Total .....		1,883,378
Contingencies, 20 per cent, say .....		376,622
Aggregate cost of south jetty extension .....		2,260,000

*North jetty.*

First half mile:		
2,640 feet of tramway, at \$5.50 .....	\$14,520	
60,000 tons of stone, at \$1.16 .....	69,600	
		\$84,120

## 2304 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

Second half mile:		
2,640 feet of tramway, at \$7 .....	\$18,480	
86,250 tons of stone, at \$1.16 .....	100,050	
		\$118,530
Third half mile:		
2,640 feet of tramway, at \$7.50 .....	19,800	
175,950 tons of stone, at \$1.16 .....	204,102	
		223,902
Fourth half mile:		
2,640 feet of tramway, at \$7.50 .....	19,800	
175,950 tons of stone, at \$1.16 .....	204,102	
		223,902
Fifth half mile:		
2,640 feet of tramway, at \$7.50 .....	19,800	
189,750 tons of stone, at \$1.16 .....	220,110	
		239,910
Total .....		890,364
Contingencies, 20 per cent, say .....		178,788
Shore work:		
Wharf at Sand Island .....	\$20,000	
22,500 feet of double track from wharf to root of jetty at Cape Disappointment, at \$3 .....	67,500	
Storage platforms and side tracks .....	17,000	
Quarters, buildings, and water supply .....	13,000	
Moving and setting up shop and plant .....	6,000	
	123,500	
Contingencies, 10 per cent. ....	12,350	
		135,850
Aggregate cost of north jetty .....		1,205,000
Aggregate cost of south jetty extension .....		2,260,000
Construction and operation of dredge .....		250,000
Total cost of project .....		3,715,000

## CONCLUSION.

The Board is aware that the total estimated cost of the two jetties recommended for the ultimate improvement of this entrance is in excess of the limits prescribed by the act of June 13, 1902, making appropriation for this work. It feels, however, that the importance of this entrance justifies the plan herein recommended for its complete and permanent improvement, and that while a partial improvement may be obtained at a less cost, no less extensive a project will assuredly secure and permanently maintain a channel 40 feet deep and of suitable width. The Columbia River entrance is the only deep-water port in the 700 miles of stormy coast between San Francisco and the Straits of Fuca, and, if suitably improved, will provide an invaluable harbor of refuge. Its value as a commercial port is well known, as is further evidenced by the fact that the people of the largest port within the entrance, Portland, have spent about \$1,000,000 of their own money in the betterment of the channel leading to their harbor.

The Board's plan is such as to permit of the carrying forward of the project within the limits prescribed by the act of June 13, 1902. After providing for the conversion of the *Grant* into a seagoing dredge, and for its operation for a temporary deepening of the bar channel, there remain available sufficient funds for the completion of the south jetty and its 2½-mile extension. This work should be pushed as rapidly as funds will permit, subject only to the limitations previously noted with regard to impracticable depths, and in the opinion of the Board it alone will secure a bar channel of greater

depth than has ever existed heretofore. . . . should, however, be made for the construction of the north . . . work may be prosecuted under the most advantageous conditions and whenever its necessity for securing a channel of the full dimensions prescribed has become evident.

The Board knows of no plan for the improvement of this entrance that has not contemplated one or two jetties extending continuously seaward from the points of the entrance that are fixed in position naturally or artificially. The turbulence of the bar is such that operations from floating plant have never been seriously considered as practicable, and any work must be executed from a structure built out from the shore. Even the structure proposed by the Reaction Jetty Company, while nominally a detached breakwater, is in effect an extension of the old jetty. The trestle from which it is proposed to construct that work must for security during several years' operations be protected by such a large quantity of stone as to form with the outer part a structure that is a continuation of the old jetty and that will act as such, although it would be of height insufficient to produce and to maintain the best results and would be so located as to push the outer bar seaward to the maximum extent.

Respectfully submitted.

W. L. MARSHALL,  
Major, Corps of Engineers.  
EDW. BURR,  
Captain, Corps of Engineers.  
J. C. SANFORD,  
Captain, Corps of Engineers.  
CASSIUS E. GILLETTE,  
Captain, Corps of Engineers.  
C. H. MCKINSTRY,  
Captain, Corps of Engineers.

Brig. Gen. G. L. GILLESPIE,  
Chief of Engineers, U. S. A.

#### APPENDIX A.

##### DESCRIPTION OF THE ENTRANCE TO THE COLUMBIA RIVER, AS SHOWN BY DIFFERENT SURVEYS.

1792. *Admiral Vancouver's chart*.—This chart is made on a small scale and, without much hydrographic detail, shows a general entrance to the river in a due eastern direction of a width of  $1\frac{1}{2}$  miles between the 3-fathom curves. Drawing a line from the southern point of Cape Disappointment to the northern point of the present Point Adams, and measuring from the middle of this line 6 statute miles due west, a depth of 27 feet is found at the most western limit of the survey, which depth can be carried, according to the chart, into the river and into Bakers Bay. No channel is shown along what is now known as Chinook spit.

This chart, "M. C. R. 3, U. S. Engineer Office, Portland," was enlarged about eight times, to a scale of  $\frac{1}{100,000}$ , and traced for comparison with surveys of later dates; it may be stated that perhaps not too much dependence should be placed upon the accuracy of the shore lines and 3-fathom curves. Relative distances of main points,

as Cape Disappointment, Point Adams, Smiths Point (then Point George), and Point Ellice, were found to agree moderately well, however, with corresponding ones upon the first United States Coast Survey chart.

The plane of reference for soundings is not known.

This early survey indicates that there was at its time a river discharge through a single channel, the 3-fathom curve of which on the north was about three-fourths of a mile south of Cape Disappointment. In the report of the Board of Engineers, February 12, 1881, when commenting upon this survey, it is stated that "the striking feature of the existence of but one channel could not have been a matter of mistake."

*1839. Sir Edward Belcher's admiralty chart.*—This chart shows a hydrographic survey of great detail. It gives the Middle Sands in the shape of a triangle, the respective angles of which are north, east, and west; the northern angle approaches Cape Disappointment to within one-half a mile; the western angle is due south of Cape Disappointment  $2\frac{1}{2}$  miles, and the eastern is due north of Point Adams  $1\frac{1}{2}$  miles. From the east angle, and running northwest with the east side of the Middle Sands, is shown for the first time Sand Island, having a length of  $1\frac{1}{2}$  miles.

It is around this triangular area of sands that channels lead to the river, after having crossed the outer bar, which in the main channel is located  $4\frac{1}{2}$  miles from a line connecting Cape Disappointment with Point Adams.

Twenty-seven feet is the best water that can be carried over the outer bar; thence the channel passes through an opening from  $5\frac{1}{2}$  to 8 fathoms deep and measuring a least width of 1 mile between the 3-fathom curves. The northern edge of this channel is  $2\frac{1}{2}$  miles south of Cape Disappointment.

After crossing the bar from the westward, one branch of this channel turns around the southern point of the sand bank now known as Peacock spit, runs in a northeasterly direction  $\frac{1}{2}$  miles to the north angle of the Middle Sands, turns about this angle to the southeastward and runs along to the east border of the sands 5 miles to its east corner, where it joins a straight channel called Queen's channel upon the chart. Queen's channel is a second branch of the main channel. It follows along the south border of the Middle Sands in a due east direction and has two entrances. One of them is an opening at the western angle of the Middle Sands  $\frac{1}{3}$  of a mile wide, with channel depths of 21 feet; the other entrance is from the southward by an opening from the sea  $4\frac{1}{2}$  miles west of Point Adams, with a depth of  $19\frac{1}{2}$  feet.

The junction of the long northern channel with the shorter, or Queen's channel, at the eastern angle of the Middle Sands, is one-half of a mile wide, showing a least available channel depth of 25 feet.

The plane of reference to which the soundings were reduced is not given; the line of low water is drawn upon the chart, to which line the soundings diminish to zero. A high-water line is also shown. Sheet No. 2 (river sheet) gives a value for the establishment of the port, and states that the tide rises 7 feet and 6 inches. This is the height of the mean of high waters above the mean of lower low waters.

The chart "M. C. R. 4, United States Engineer Office, Portland," was reduced from a scale of 4 inches to a nautical mile to a scale of  $\frac{1}{10000}$ , and traced for the purpose of comparing readily the conditions of the mouth of the river at times of this survey and other surveys.

*1841. Chart of Captain Wilkes's exploring expedition.*—This chart shows the position of the Middle Sands; the position of the long sand bank known as Peacock Spit, hinged to and extending  $2\frac{1}{2}$  miles southward from Cape Disappointment; Chinook Spit, extending in a north-westerly direction from Chinook Point, and the northern edge, 4-fathom curve, of what is known as Clatsop Spit, which line runs on a course almost due west of Point Adams.

The sand banks make two channels, viz, a direct one from the entrance south of Peacock Spit, running due east, bounded by the southern edge of the Middle Sands and the northern edge of Clatsop Spit, and a channel running northerly between the east edge of Peacock Spit and the west border of the Middle Sands, into Bakers Bay, turning here to a southeasterly direction between the east border of the Middle Sands and the 3-fathom curve of the northern shore; both channels join at the east angle of the triangular middle sand bank. Through their junction a depth of  $4\frac{1}{2}$  fathoms may be carried into the main (Astoria) channel of the river.

The outer bar gives least channel depths of  $4\frac{1}{2}$  fathoms at a distance of  $4\frac{1}{2}$  miles from the line connecting Cape Disappointment with Point Adams. Beyond that distance the water rapidly deepens.

The southern (Clatsop) channel was then the more direct way into the river; depths of 27 feet could be carried through it; the distance from the bar to that part of Clatsop channel north of Point Adams measured about 7 miles.

This map shows no entrance to the direct channel from the southward, the hydrography not having been carried below the northern 4-fathom curve of Clatsop Spit.

To what plane the soundings were reduced in this survey the chart makes no note, but as high and low water lines are given and the soundings diminished toward the latter to zero it is judged that low water was the adopted plane. That a series of tidal observations were made is shown by the fact that the symbol for the establishment of the port is given upon the chart, which value ( $X11\frac{1}{2}$ ) does not vary more than a few minutes from the latest determinations of the Coast Survey.

This map, "M. C. R. 5, U. S. Engineer Office, Portland," was reduced from a scale of 3 inches to a nautical mile to a scale of  $\frac{1}{10000}$  and traced for ready comparisons with previous and subsequent surveys.

*1851. United States Coast Survey chart.*—This chart was published in 1851. The following extracts are made from the Coast Pilot:

The first examination of the Columbia River entrance by the United States Coast Survey was made in 1850. This survey shows the following changes since 1841:

The South Sands (now called Clatsop Spit), which in 1841 stretched 6 miles to the westward from Point Adams, had been cut through about midway between the point and their western extremity by a wide channel with deep water running south by west from Sand Island; but the bar of this channel was not fairly opened, there being less than 3 fathoms on it. This channel was, therefore, running at right angles to that of 1841 and over the spot marked bare in 1839 ("C. F. P.).

The north channel retained the same general features, but had moved to the southward, its southern part cutting away over a mile of the west end of the South Sands of 1841. It still had over a fathom more water than the south channel. Inside of Cape Disappointment it retained the same general direction as in 1841, but was more contracted.

The Middle Bank (Middle Sands) was much changed, but its northern part was similar to that of previous surveys. The eastern point had moved north-north-

west three-fourths of a mile since 1841. Sand Island had much increased in size, and had apparently moved with it. A long sand bank had made out from Point Adams in a northwest direction for over a mile. It was then, and is now, called Clatsop Spit.

The western end of the great middle shoal eastward of Point Adams had been cut away three-fourths of a mile.

The bar is shown upon this chart in the north channel halfway up its length to Cape Disappointment, and 1 mile westward of the line connecting Cape Disappointment and Point Adams, with a best depth of 27 feet.

After crossing the bar the north channel is open, with good depths of water, to and around the northern angle of the Middle Sands. The least water found in this passage is along the northeastern side of the Sands, where depths of 21 and 22 feet are given.

The soundings are reduced to the plane of mean low water.

1854. *United States Coast Survey chart*.—This chart was published in 1854 with the hydrography of 1852. Two distinct and separate entrances are shown to exist—one from the westward, 3 miles south of Cape Disappointment, and the other from the southward,  $3\frac{1}{2}$  miles southwest of Point Adams, caused by the Middle Sands, which extend from north to south across the mouth of the river.

The outer bar is shown at the entrance of the north channel, 3 statute miles from the line connecting Cape Disappointment with Point Adams. Twenty-seven feet may be carried through the channel, with good depths of water, to Bakers Bay anchorage. The channel northeast of the Middle Sands from the bay to the river carries 21 feet. The better entrance into the river is now through the south channel, where, after crossing a narrow bar with 21 feet of water upon it, a channel nearly 1 mile wide, with good depths, is open. From the entrance the channel runs 3 miles to northward, and thence eastward to deep water of the river.

The soundings are reduced to the mean lower low water.

This chart "M. C. R. 7, U. S. Engineer Office, Portland," scale  $\frac{1}{100,000}$ , was traced for a ready comparison with other surveys.

1868. *United States Coast Survey chart*.—This chart was published in 1874, with the hydrography of 1868, and shows a north channel between Peacock Spit and the Middle Sands. The entrance of it is 3 miles southwest of Cape Disappointment, where a depth of 21 feet may be carried over the bar into Bakers Bay. At the junction of this channel with the main one of the river 21 feet exist (Chinook channel).

The south channel opens from the southward with an entrance 2 miles wide, its central line lying 4 miles west of Point Adams. Depths not greater than 25 feet may be carried into the deeper water of the river.

Soundings are reduced to the mean lower low water.

1876. *United States Engineer Survey, Assistant Engineer Jessen*.—Twenty-two feet may be carried over the outer bar of the north channel, 3 miles west of line from Cape Disappointment to Point Adams, with good depths to Bakers Bay.

The Chinook Spit channel bar shows best depths of from 13 to 19 feet.

The south channel has least depths of 20 feet at its entrance.

The soundings are reduced to the mean lower low water.

1878. *United States Engineer Survey, Lieutenant Payson*.—The outer bar near the entrance of the north channel, distant 3 miles from



the line of Cape Disappointment and Point Adams, shows greatest depths of 23 feet, which may be carried over it to deeper water of Bakers Bay. The bar in Chinook Spit channel has depths from 15 to 17 feet. The entrance to the river is by the south channel, which shows at its mouth a narrow opening of 20 feet depth.

The soundings are reduced to the mean lower low water.

1879. *United States Engineer Survey, Assistant Engineer Jessen.*—The outer bar at the entrance to the north channel is distant from the reference line heretofore taken 5 miles. Twenty-three feet can be carried over this bar into Bakers Bay.

Chinook Spit channel is still shoaling. It was scraped during the year, but without any decided gain of depth. Its bar shows channel depths from 14 to 15 feet.

The entrance to the main river channel is by the south channel,  $3\frac{1}{2}$  miles due west of Point Adams. Depths of 20 feet only can be carried through this channel.

The soundings are reduced to the mean lower low water.

1880. *United States Engineer Survey, Assistant Engineer Jessen.*—The outer bar at the entrance to the north channel is distant from the reference line  $2\frac{1}{2}$  miles. Depths of 21 feet may be carried over it into Bakers Bay.

The bar in Chinook Spit channel extends along the entire eastern border of Sand Island. The channel depths upon it vary from 14 to 15 feet.

The Middle Sands hinged to Sand Island show a gradual deepening at a point  $1\frac{1}{2}$  miles due south from Cape Disappointment, where a bar less than one-fourth of a mile in width may be crossed with from 17 to 18 feet of water upon it. The surveys of 1878 and 1879 show this severance between Sand Island and the Middle Sands to have been gradually increasing.

The former survey shows this bar to have been a little over and the latter a little less than one-half mile in width. The narrow ridge was scraped this year with favorable result. This connection between the main channels is called the cut-off.

Nineteen feet is the best water over the bar of the south channel.

The soundings are reduced to the mean lower low water.

This chart, "M. C. R. 16, Engineer Office, Portland," was traced for a ready comparison with other surveys.

1881. *United States Engineer Survey, Lieutenant Price.*—The outer bar near the entrance to the north channel is distant 2 miles from the reference line.

Twenty feet of water is stated in the report of the survey to be the best depth which can be carried over the bar to Bakers Bay.

The severance (cut-off) between the Middle Sands and Sand Island has now the shape of a short narrow channel, 20 feet in depth, connecting the north and south channels.

The bar in Chinook Spit channel has been filled to depths from 12 to 13 feet.

The entrance to the south channel has been gradually shoaling with formation of lumps. The depths found here are from 17 to 19 feet.

The passage to the river is now made by crossing the bar of the north channel, thence by this channel  $2\frac{1}{2}$  miles in a southeasterly direction to the cut-off, crossing at that point to the south channel and the deeper water of the river.

Soundings are reduced to the plane of lower low waters.

1882. *United States Engineer examination, Lieutenant Price.*—Best depths on outer bar near mouth of north channel are 19 feet.

The cut-off shows depths of 22 feet, with a good channel of 21 feet.

The south channel has been virtually closed to deep-draft vessels by many lumpy formations at its entrance. Depths varying from 15 to 17 feet only are found here. The soundings were reduced to the plane of the lower low waters.

The minor channel across the Middle Sands, about halfway between the north and south channels, whose formation was first noticed in 1879, has now a depth of 17 feet on a straight line. An unsuccessful attempt was made to deepen this new channel by stirring up the bottom with large harrows.

1883. *United States Engineer survey, Assistant Engineer Von Geldern.*—This survey included a development of Clatsop and Peacock spits and soundings in Bakers Bay.

The north channel had become narrower since 1881 and had shoaled to 18 feet on the sea bar. It had also moved three-fourths mile to the north into an almost northwesterly direction.

The south channel had become the ship channel and had worked three-fourths mile nearer Clatsop Spit to an almost due south direction. There had been a general increase in depth to 20 or 21 feet, with lumps having a depth of 18 or 19 feet.

Tillamook Chute, the swash channel across Clatsop Spit, whose existence was known in 1881 but not shown on chart of that year, had increased in importance and moved to the north. It carried 12 feet nearly across the spit.

The Fort Stevens bar had about the same depth on it as in 1881, 20 feet.

Sand Island had been pushed farther north into Bakers Bay by the main channel and the inside channel into Bakers Bay had shoaled.

The cut-off channel into Bakers Bay west of Sand Island showed tendencies toward shoaling. Peacock Spit was shoaling at its inner end and extending toward Sand Island.

1885. *United States Engineer survey, Lieutenant Burr.*—A complete survey of the channels, spits, and Bakers Bay from Fort Stevens to the sea.

The south channel was the only one used by deep-draft ships. Its depth, 20 feet, and location were essentially the same as in 1883, the movement toward Clatsop Spit having been only one-fourth mile. There were fewer lumps in the channel.

The north channel had shoaled to 17 feet and moved farther north, close to Cape Disappointment. It had practically disappeared, being used only by light-draft vessels from the north.

The Fort Stevens bar had shoaled to 19 feet.

Tillamook Chute had moved northwest 1,500 feet, and while it had not increased in area it had increased in depth. Clatsop Spit had gained in depth outside the 6-foot contour and had extended in all directions, most markedly toward the west.

The northward movement of the main channel continued and Sand Island moved correspondingly into Bakers Bay. Bakers Bay had not shoaled materially. The inside channel east of Sand Island had shoaled to 8 feet from the 16-foot depth of 1881, and the cut-off channel to 14 feet from 26 feet in 1881.

Peacock Spit had shoaled in all directions joining on to Sand Island on the east and the Middle Sands on the west. A breach had been made through Sand Island at the elbow.

The depth on the Middle Sands had increased generally, and on the southwest quadrant of the bar the sea slope had moved seaward noticeably.

Preliminary steps were taken for beginning the construction of the jetty across Clatsop Spit.

*1886. United States Engineer examination.*—A survey of the ship channel and Clatsop Spit.

The south channel had continued to lengthen by shifting toward the southeast, its depth and width remaining about the same as in 1885.

Tillamook Chute had not deepened but the river end had widened and moved toward the end of the spit.

Work upon the shore end of the jetty was under way.

*1887 and 1888.*—No surveys or examinations were made in 1887 and 1888, but it was known from pilots and others that the north channel had disappeared and that the south channel had practically the same depth and location as in 1886. Peacock Spit had joined completely to the Middle Sands, over which the depth was about the same as in 1885.

The construction of the jetty had extended to a length of about one-half mile by August, 1886, but had not shown any effect on the channels.

*1889. United States Engineer survey, Assistant Engineer Clapp, in September and October.*—A complete survey of the channels, spits, and Bakers Bay from Fort Stevens to the sea, made near the end of the working season.

At the time the survey was made the jetty had reached a length of about  $2\frac{1}{2}$  miles, nearly all of which had been raised to or near low-water level.

Earlier in the season the channel was reported as having a tendency toward a straight course out to sea, and marked changes were evident in Clatsop Spit, which showed much more area bare at low water.

At the time the 1889 survey was made the condition of the channels and spits was as follows:

The entire southwest quadrant of the bar had deepened to 20 and 22 feet, with many lumps of 19 feet, but only a few less than 19 feet. Several 20 to 21 foot channels existed, the buoyed channel running out southwest to the sea about 2 miles northwest of the 1885 channel. The Middle Sands had thus practically disappeared.

The sea slope of the bar moved seaward along its westward face. From the 1889 channel line south along the face of Clatsop Spit there was a marked recession of the sea slope, and in the northwest section there was a similar recession of less extent.

Peacock Spit showed a remarkable development, having shoaled to depths of about 5 feet for a distance of nearly  $2\frac{1}{2}$  miles from Cape Disappointment. At this time it had in this direction its greatest known development in height.

The east and west channels into Bakers Bay had shoaled to 5 feet and 10 feet, respectively, and were never afterwards used by any but light-draft vessels.

The northward movement of the main channel had continued, carrying Sand Island farther into Bakers Bay.

Marked changes had taken place about Clatsop Spit. The Fort Stevens bar had deepened to 24 feet from 19 in 1885. Clatsop Spit had shoaled materially and extended, particularly at its northwest corner. Tillamook chute had almost disappeared.

*1890. United States engineer examination.*—An examination of the channel across the outer bar.

The channel over the outer bar had deepened to 24 feet, but had not shifted in position. The distance between the inner and outer 30-foot contours had been reduced from  $1\frac{1}{2}$  miles in 1885 to 1 mile.

The jetty had been extended to a length of  $3\frac{1}{4}$  miles, of which 3 miles had an average height of low water. Large accretions of sand had been made in the vicinity of the jetty, and large areas were bare at extreme low water.

*1891. United States engineer examination, Assistant Engineer Hegardt.*—An examination of the channel from the end of the jetty to the sea.

The jetty had been raised to low water for a length of 4 miles. The accumulation of sand in the vicinity of the jetty had continued, particularly on its sea side, and large areas were 2 and 3 feet above low water.

The channel across the outer bar had deepened to 27 feet for a width of one-half mile and had moved to the north 2,000 feet from the 1890 location, but the bar crossing was still pointed to the southwest. The 30-foot contours were one-half mile apart where they approached each other nearest.

*1892. United States engineer examination, Assistant Engineer Hegardt.*—An examination of the channel and spits from the end of the jetty to the sea.

The jetty had been extended to its full length,  $4\frac{1}{4}$  miles. All of it had been raised to low water, much of it to mid tide, and the shore end to high tide for a length of 1 mile. The accumulation of sand in the jetty area had continued, and the main position of it on the sea side had an elevation of 3 or 4 feet above low water.

The channel over the bar was 27 feet deep for a width of 1 mile, with a central depth of 28 feet of insufficient width. It had moved north one-third mile since 1891 (three-fourths mile since 1890), but still pointed southwest on the bar crossing. The 30-foot contours had approached to within one-fourth mile of each other on the line of the 1891 channel.

The crest of the bar had shoaled for the 2 miles southwest of the end of the jetty, and had deepened markedly over the entire westerly extension of Peacock Spit, that had been so shoal in 1889. In the entire northwest quadrant of the bar the sea slope had advanced materially, and in the southwest quadrant there had been a similar recession of the sea slope since 1889.

*1893. United States engineer survey, Assistant Engineer Hegardt.*—A complete survey of the channels, spits, and Bakers Bay from Fort Stevens to the sea.

The jetty had been raised to high tide for 2 miles of the shore end, and the remainder was about 3 feet above low water. The accumulation of sand in the jetty area had continued and reached a height of  $5\frac{1}{2}$  feet above low water over a large area. It was therefore beginning to drift across the jetty in places.

The channel had shifted slightly to the north to a distance of five-sixths of a mile from the 1890 position, but still pointed southwest on the bar crossing. The 27-foot channel was three-fourths of a mile wide, and there was a 29-foot channel of available width. The 30-foot contours had come together at one point, but a 30-foot channel depth was not available, and they were generally three-fourths of a mile apart.

The Fort Stevens bar had deepened to 29 feet.

Peacock Spit continued to deepen west of Cape Disappointment. The channel west of Sand Island into Bakers Bay remained of the same depth, 8 to 10 feet, and east of the island had a depth of but 4 feet.

A Board of Engineers was convened to consider the completion of the work, and recommended the raising of the jetty to 12 feet above datum (mean lower low water) at the shore, sloping thence to 10 feet at 1.8 miles and to 4 feet at the outer end. No extension was recommended.

*1894. United States engineer examination, Assistant Engineer Hegardt.*—An examination of the bar channel.

The jetty had been raised to 10 feet above low water at the shore end, sloping to 7.5 above low water at  $2\frac{1}{2}$  miles and to mid tide from that point to the end. Work had been suspended for lack of funds.

The shoaling of the bar southwest of the jetty end had continued, with a northerly movement, and had grown to be a distinct shoal, extending west and northwest.

The channel had shifted slightly to the north and was nine-tenths of a mile from the 1890 position, but still pointed southwest on the bar crossing. Its depth remained the same as in 1893, 29 feet, but its width was greater. The 27-foot channel was  $1\frac{1}{2}$  miles wide and the distance between the 30-foot contours was the same as in 1893.

The Fort Stevens bar had deepened to 30 feet, an increase of 11 feet since 1885.

The channel west of Sand Island into Bakers Bay had continued to shoal and become narrower.

*1895. United States engineer survey, Assistant Engineer Hegardt.*—A complete survey of channels, spits, and Bakers Bay from Astoria to the sea.

The jetty had been practically completed in accordance with the original and revised projects, which projects provided for a height of 12 feet above lower low water at the shore end, sloping to 10 feet in a distance of 1.8 miles, and thence to 4 feet at the outer end.

The accumulation of sand in the jetty area had continued on the sea side of the jetty; the spits had not materially increased in area, but had increased in elevation, and large areas were bare at mean high tide. The northerly movement of sand across the jetty continued. The spits had almost become an extension of the Point Adams beach, being separated from it by only a narrow channel.

The channel over the outer bar had moved north two-fifths mile since 1894,  $1\frac{1}{2}$  miles since 1890, and  $3\frac{1}{2}$  miles since 1885, and still continued to point to the southwest, although the channel west of Sand Island ran out almost due west to the sea. The bar channel had a depth of 30 feet for a width of seven-eighths mile and 31 feet for a width of one-half mile, the maximum bar depth so far as known.

The Fort Stevens bar had a depth of 32 feet.

The shoal extending west from the end of the jetty had extended and lost depth. It formed the southwest quadrant of the bar and its crest was shoaler than at any time since 1881 prior to 1902. The northwest sector of the bar and the spits extending seaward from Peacock Spit had increased in depth since 1889 and 1892. Peacock Spit itself had largely decreased in area, the 12-foot contour being about parallel to the coast line of Cape Disappointment and but little more than one-half mile from it. South and inside of the cape Peacock Spit had shoaled, parts of it being bare at and above low water, and

the channel between it and Sand Island had narrowed, but retained the same depth.

The northerly movement of the main channel at Sand Island had ceased. The wearing of the north bank continued at a much reduced rate, but the cutting back of the south bank shifted the mid-section line southward.

The sea slope of the bar south of the channel had receded, as had also the sea slope of Clatsop Spit beach to a less extent. North of the channel the sea slope of the bar had advanced markedly since 1889 and 1892.

*1896. United States engineer survey, Assistant Engineer Hegardt.*—A complete survey of the channels, spits, and Bakers Bay from Astoria to the sea

The condition of the jetty remained as in 1895, with the exception that the level of the extreme outer end had been reduced to low water by the leveling action of the sea. The accumulation of sand in the jetty area had continued and this survey shows for the first time the high-water line of Clatsop Spit extending north across the jetty, with a hook trailing upstream. The small channel between the spit and Point Adams had narrowed and shoaled.

The bar channel had moved materially to the north, the movement amounting to seven-eighths mile since 1895,  $2\frac{1}{8}$  miles since 1890, and  $4\frac{3}{8}$  miles since 1885. Over the bar it still pointed to the south of west, although nearer west than in previous years. The general direction of the channel from the gorge to the sea was north of west. On the bar it had shoaled materially, being but 30 feet deep for a narrow channel and 29 feet for a width of seven-eighths mile.

The Fort Stevens bar had about the same depth as in 1895, 31 or 32 feet.

The southwest section of the bar (the shoal extending westerly from the end of the jetty) retained about the same position as in 1895, but showed a distinct scour and deeper water across it. The 30-foot contour on that side of the channel also moved south.

A noticeable change was evident in Peacock Spit, which had receded inshore materially. The 12-foot contour was nearer the coast, and the area bare at low water was almost entirely within the cape, trailing to the southeast and nearer to Sand Island. A swash channel across the spit was shown, and the channel into Bakers Bay had shoaled to 3 feet and become much more narrow.

*1897. United States engineer examination, Assistant Engineer Hegardt.*—A survey of the bar and channel from the end of the jetty to the sea.

The jetty and Clatsop Spit remained in about the same condition as in 1896.

The bar channel retained the same position and depth, but the 30-foot channel was 2,000 feet wide. The 27-foot channel was seven-eighths mile wide.

On the southeast section of the bar there was a continuation of the deepening noted on the previous survey across the shoal extending northwesterly from Clatsop Spit and the contours on that side of the channel had moved to the south. To the southwestward of the jetty the shoaling appeared to have been considerable, but no soundings were available for exact information.

The movement of Peacock Spit toward the east and of Sand Island continued, with an increase of the swash channel previously noted and a decrease of the old Cut-off channel.

*1898. United States engineer examination, Assistant Engineer Hegardt.*—A survey of the bar and channel from the jetty end to the sea.

No material change was apparent in the jetty and Clatsop Spit.

A noticeable change had occurred in the bar crossing. The channel over the outer bar, which had pointed persistently to the southwest, or south of west, had shifted at its outer end 1 mile to the north since the previous survey and for the first time since the disappearance of the old north channel now pointed northwest, a swing of about  $55^\circ$ , the inner end of the channel remaining in about the same location as in 1897.

The bar channel had also lost 1 foot in depth and was but 29 feet for a width of 2,000 feet, with a distance of three-fourths of a mile between the inner and outer 30-foot contours; the 27-foot channel was seven-eighths of a mile wide.

The southwest section of the bar continued to deepen. The 24-foot contour had advanced northwest  $1\frac{1}{4}$  miles toward the channel, but the 18-foot contour had receded southeast  $1\frac{1}{4}$  miles, and the 12-foot contour was south of and almost opposite the jetty end. The inside channel contours had also moved south.

At Peacock Spit the receding of the outer contours and the movement of the bare part of the spit toward Sand Island had continued. The latter was almost connected with Sand Island at low water and the old Cut-off channel had disappeared, while the new swash channel had increased and become the only open water between Sand Island and Cape Disappointment.

*1899. United States engineer survey, Lieutenant Fries.*—A complete survey of the bar spits and channel from Fort Stevens to the sea.

The jetty remained as in previous years. A project for a 40-foot channel was inaugurated.

Clatsop Spit had continued to grow in elevation and to extend in the direction of its length. The low-water line had connected with Point Adams, obliterating the remains of the old swash channel, and had also extended toward the jetty end.

The channel over the outer bar remained in the same position as in 1898, pointing northwest. It had continued to shoal, having a depth of but 28 feet for a width of five-eighths of a mile and 27 feet for a width of seven-eighths of a mile. The 30-foot contours were from  $1\frac{1}{4}$  to  $1\frac{1}{2}$  miles apart. The Fort Stevens bar had deepened to 33 feet.

The southwest section of the bar continued to deepen and the contours on its channel side to move south. The end of the 24-foot contour receded slightly from the bar channel and the 18-foot contour advanced. There appeared to be indications of Clatsop Spit working out to the end of the jetty, shoaling being apparent on both sides nearly to the end.

The sea slope of Clatsop Spit continued to deepen and recede outside the 18-foot contour, but the 18-foot contour and the high and low water lines remained as in 1895. In the southwest section of the bar there was no marked change in the sea slope, although the crest of the bar had been lowered, a slight advance being shown at some points and a recession at others. The same conditions existed in the northwest sector, although the channel swung across it between 1895 and 1899.

The change in Peacock Spit had continued. The outside contours had receded until the 18-foot contour was but three-eighths of a mile from the shore line and the 24-foot contour was distant about 1 mile.

U.S. G.

The bare portion of the spit, now known as Republic Spit, had become attached to Sand Island, and other bare areas had risen between it and the cape. The channel face of the spit had been pushed south, the 30-foot contour having shifted 1,000 feet since 1895.

In the main channel at Sand Island the north bank had shifted north 500 feet since 1895. With the northerly movement of the south bank, which had receded between 1889 and 1895, there had also been a northerly movement of the midsection line which in this year (1899) occupied about the same position as in 1885.

Congress authorized the preparation of a project for an increase in the depth of the bar channel to 40 feet, and a report thereon was submitted by the district engineer recommending a 3 mile extension of the jetty.

1900. *United States engineer examination, Assistant Engineer Hegardt.*—A survey of the bar and channel from the jetty end to the sea.

No change is shown in the jetty or in Clatsop Spit of importance.

The channel across the outer bar had moved north two-fifths of a mile, pointing toward the northwest, and had shoaled 4 or 5 feet. There was only a narrow channel 24 feet deep and a 23-foot channel 1 mile wide. The distance between the 30-foot contours was  $2\frac{1}{2}$  miles and was greater than on the southwest section of the bar, where it averaged about  $1\frac{1}{2}$  miles.

For the first time since 1890 the 24-foot contours were continuous from Clatsop spit to Peacock Spit. There was a material shoaling of the northwest and west sections of the bar, although the 12 and 18 foot contours retained about the same position west of Cape Disappointment. In the southwest section there had been a deepening for 2 miles west of Clatsop Spit, and from there on northwest a shoaling, the 18-foot curve having advanced 1 mile.

In the channel west of the jetty end the contours on the south side had suspended their previous movement to the south. On the north side the 30-foot contour remained about the same, but the 18 and 24 foot contours had worked south and more noticeably west, indicating a tendency of Peacock Spit to build up again toward the west.

1901. *United States engineer examination, Assistant Engineer Hegardt.*—A survey of the bar and channel from the jetty end to the sea.

No change of importance is shown in the jetty or in Clatsop Spit, excepting a continuance of the shoaling on both sides of the jetty near its end.

The bar channel had shifted one-eighth of a mile farther to the north and shoaled to 23 feet, with a width of 1,000 feet. The distance between the 30-foot contours at the channel remained  $2\frac{1}{2}$  miles, while on the southwest sector of the bar it had narrowed to  $1\frac{1}{2}$  miles. The 24-foot contours were half a mile apart.

On the southwest sector of the bar there had been no radical change since 1899, excepting a deepening just west of the end of the jetty. In the remainder of this section there had been a slight deepening in some places and shoaling in others.

In the western sector of the bar, just north of an east and west line through the gorge, there had been a deepening where a shoaling was shown by the previous survey.

The sea slope of Clatsop Spit continued to deepen and the low-water line receded slightly, but the 18-foot contour and the high-water line retained the same positions as in 1895 and 1899, respectively. There



Plate I.

+

+

+

+



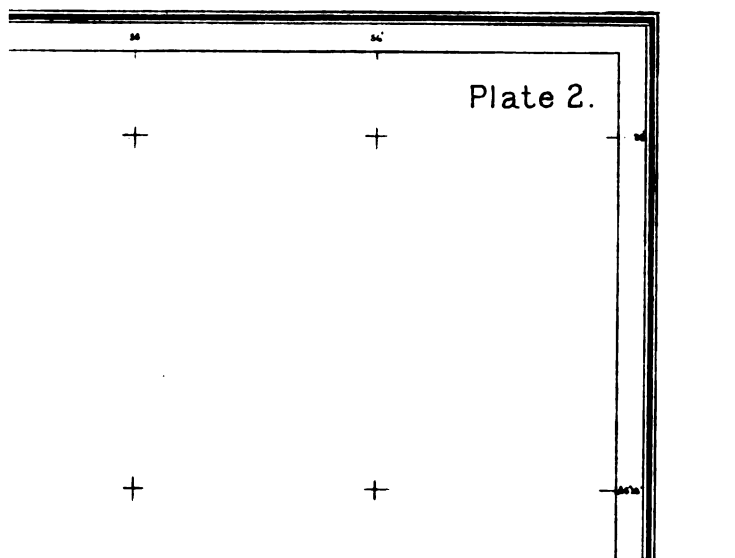
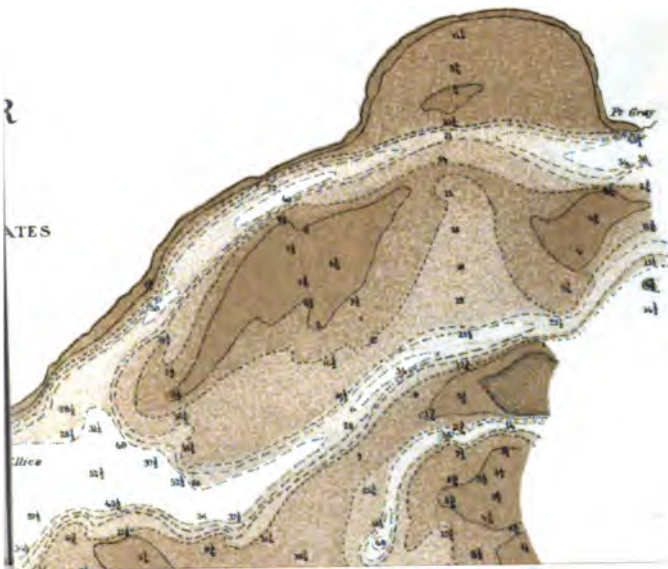
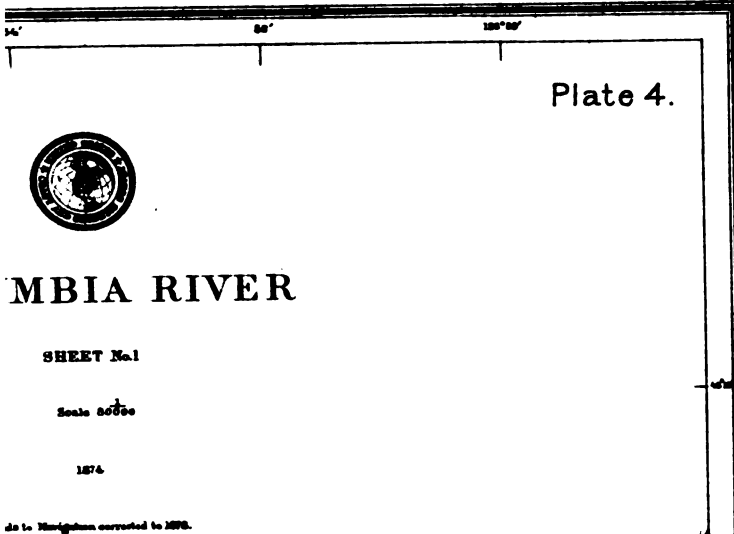




Plate 3.













# UMBIA RIVER

SHEET No. 1

Scale 60000

BOUNDINGS IN FEET.

1881

Aids to Navigation corrected to 1882.

Plate 5.



54 55 112 90

Plate 6.



# OMBIA RIVER

SHEET No. 1

Scale 50,000

1885

As to Navigation corrected in 1908



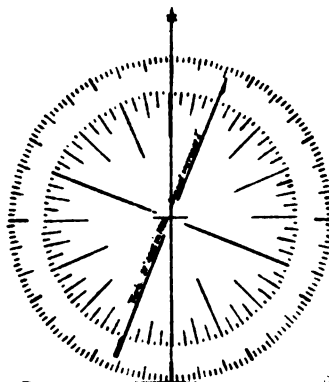


# JMBIA RIVER

**SHEET No.1**

**Final score**

1999.



Smith and J. J. Gilbert Associates Inc. 1988 and 1977-78  
 Staff Assist. between . . . . . 1988 and 1989  
 Reference from a survey by the Corps of Engineers 1984 to 1989  
 by Don P. Ekins to Tracy H. and offshore soundings  
 between Associates in 1984 and 1989  
 by J. J. Gilbert and J. J. Gilbert Associates Inc. 1988 and 1989  
 by J. J. Gilbert Associates Inc. and J. J. Gilbert Associates Inc.  
 Smith and J. J. Gilbert Associates Inc. 1988 and 1989  
 survey by Smith and J. J. Gilbert Associates Inc. 1988 and 1989





Plate 8.

# UMBIA RIVER

SHEET No. I

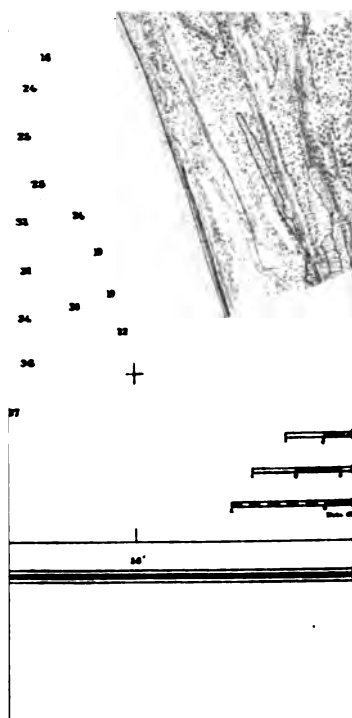
Scale 60000

1890

R. D. Catts and J. J. Gilbert Assistants to ..... 1878 and 1879-76  
Richard, Asst. Engr. 1880 and 1881  
The Entrance from a survey by the Corps of Engineers U.S.A. in 1860-66  
is from P.M. 100 to T.M. 70 and all other soundings  
C. Richard, Assistant to ..... 1880 and 1881  
surveyed by G. Davidson and R. D. Catts Assist. in 1861 and 1862  
Survey by G. Davidson Assist. in 1861 and W. Burdett Robt. Asst. and  
J. E. Nichols U.S.N. Assistant, ..... in 1873 and 1881  
Hydrography by Comdr. C. M. Thomas U.S.N. Inspector of Hydrography

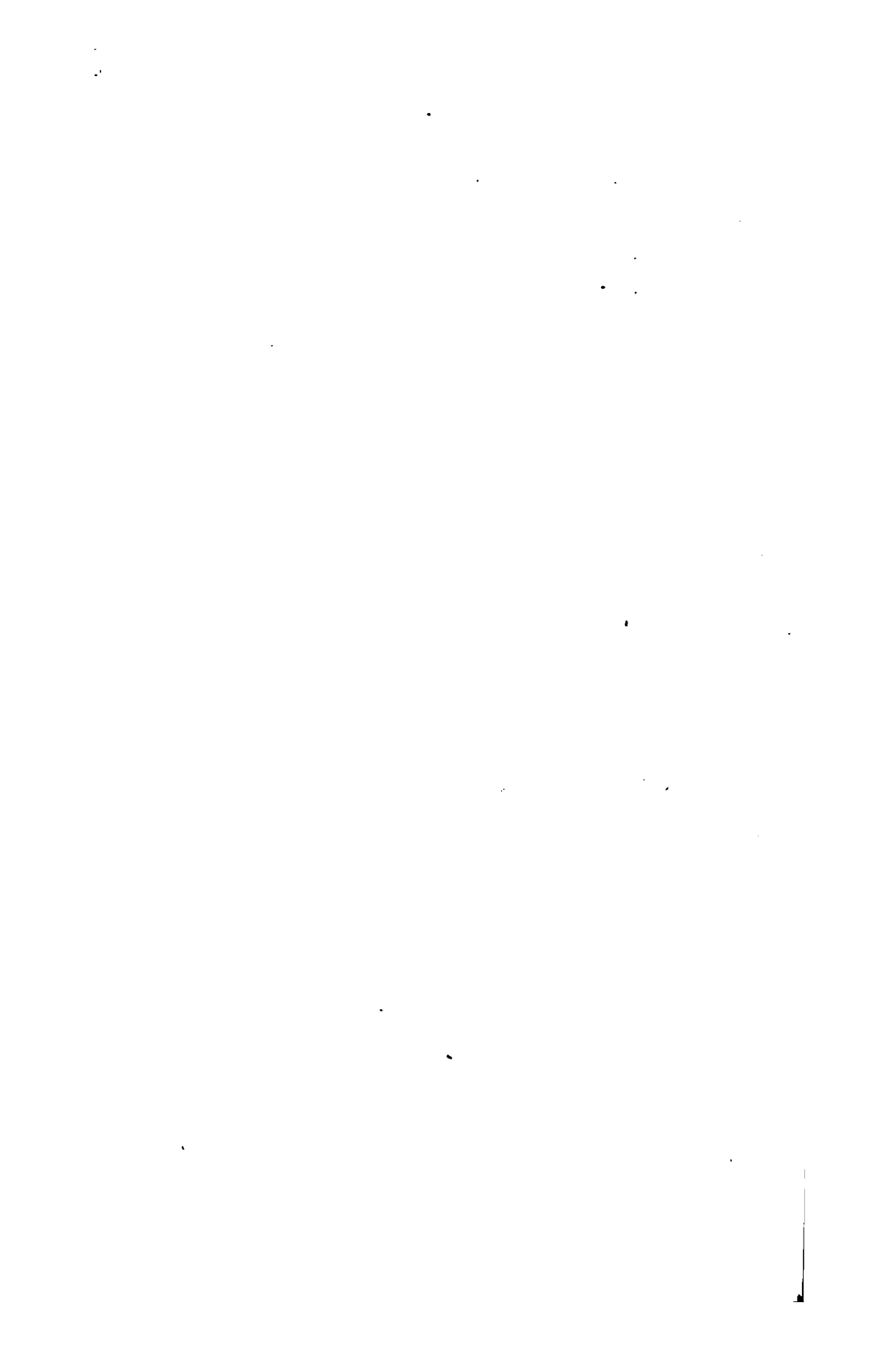


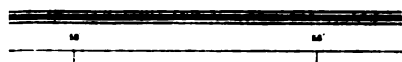
























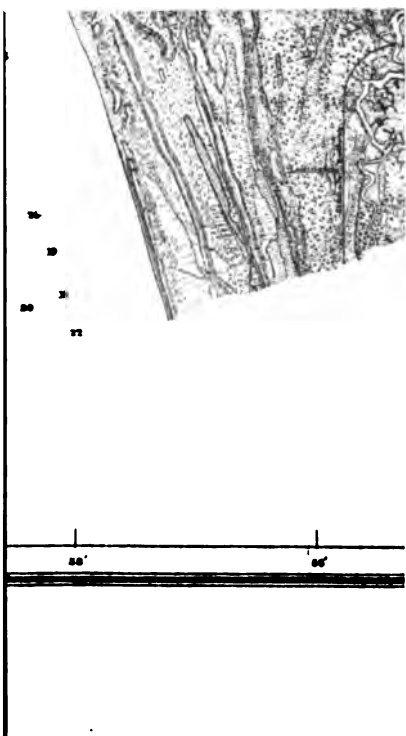




Plate 15.

IMPROVEMENT  
OF  
OF THE COLUMBIA RIVER.

Survey made June 18-30, 1897, under the direction of  
CAPTAIN W. L. FISK, CORPS OF ENGINEERS U. S. A.

BY  
C. B. HEGARDT, ASSISTANT ENGINEER.

Soundings are expressed in feet and show the depth  
at the average of the lowest low waters.

1 N C T O N +



15' 30' 45' 125' 00'

Plate 16.

**ENTRANCE  
TO THE  
COLUMBIA RIVER.**

**JULY 1898.**

*Soundings are expressed in feet and show the depth at the average of  
the lowest low waters.*

4  
1  
N G T O 7  
+





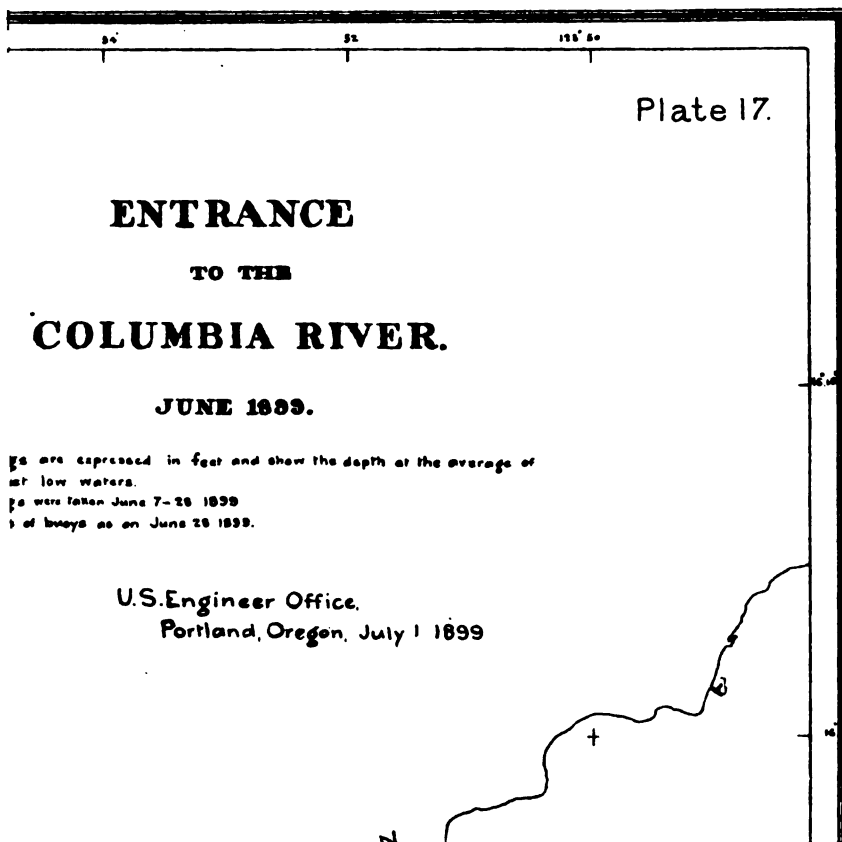


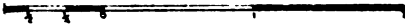


Plate 18.

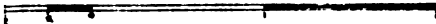
**ENTRANCE  
TO THE  
COLUMBIA RIVER.  
JUNE 1900**

is are expressed in feet and show the depth at the  
of the lowest low waters.

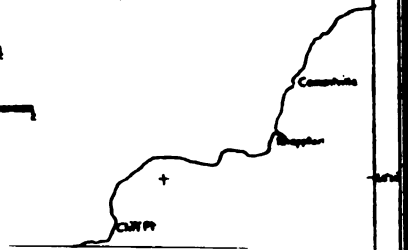
Statute Miles.



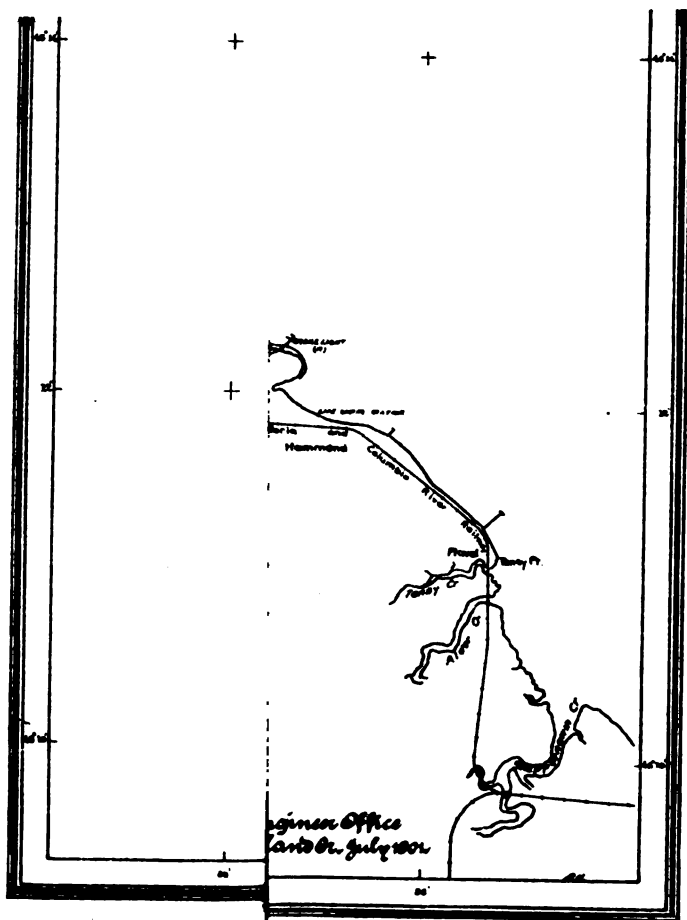
Nautical Miles



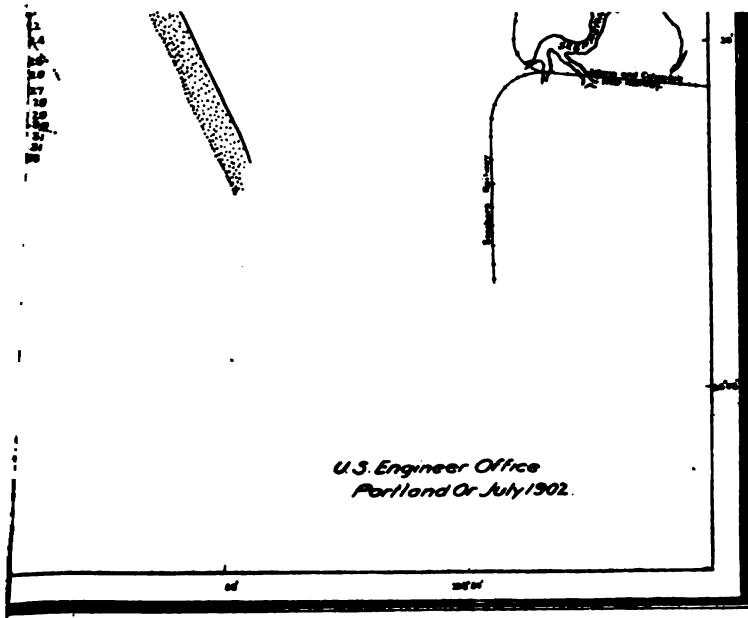
position of Buys is shown as located by  
U. S. L. H. Department July 27, 1900.







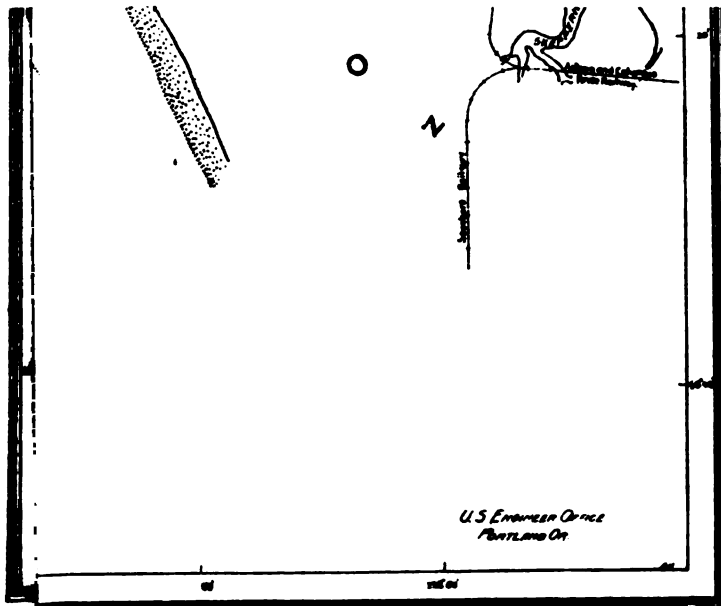




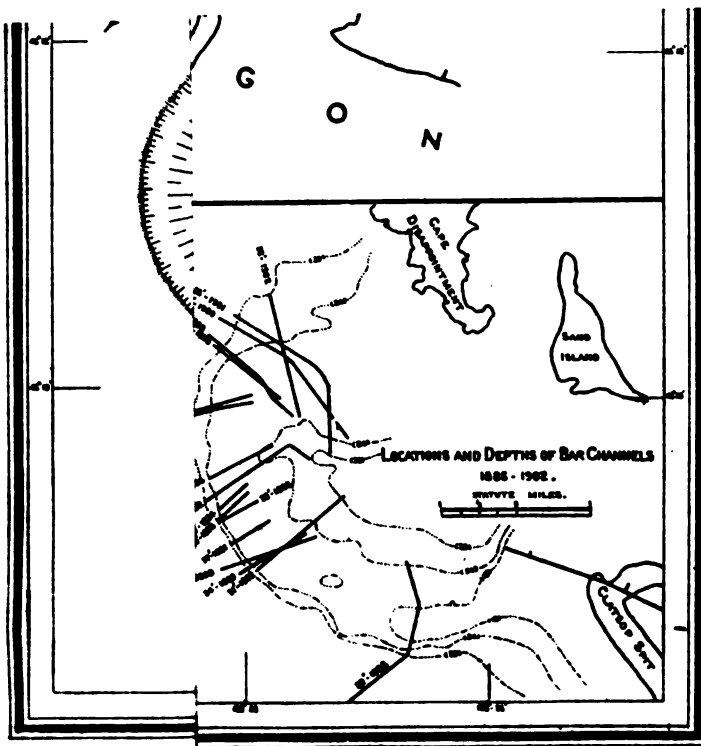
U.S. Engineer Office  
Portland Or July 1902.









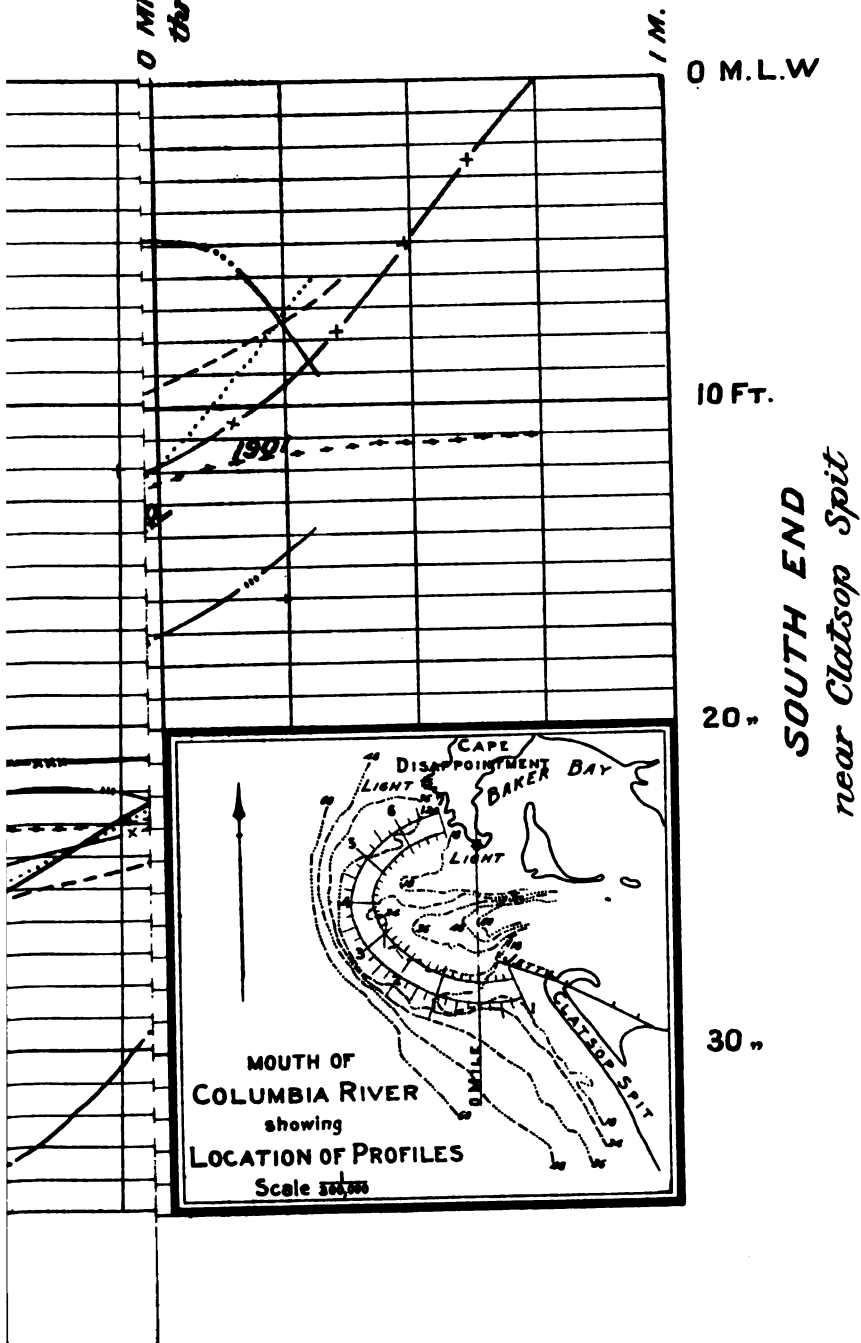


ANDREW B. GRAHAM PHOTO LITH.



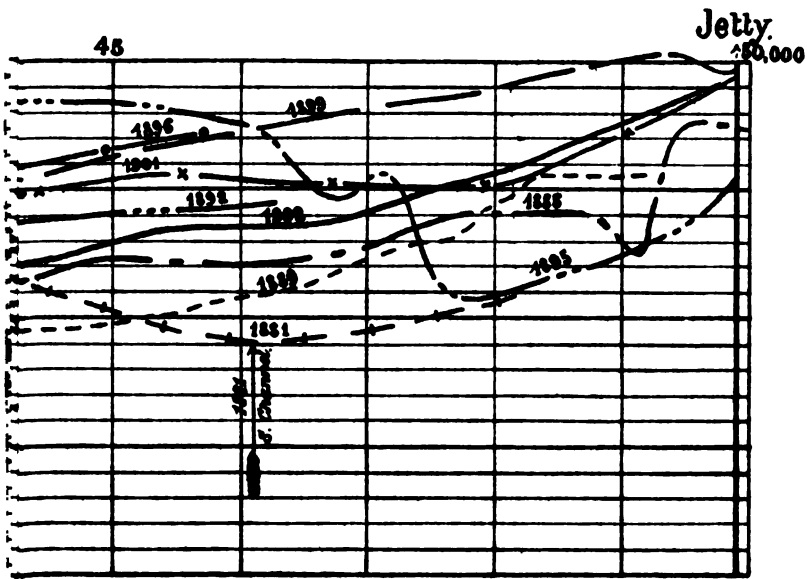
ile in  
n the

# Plate 23.





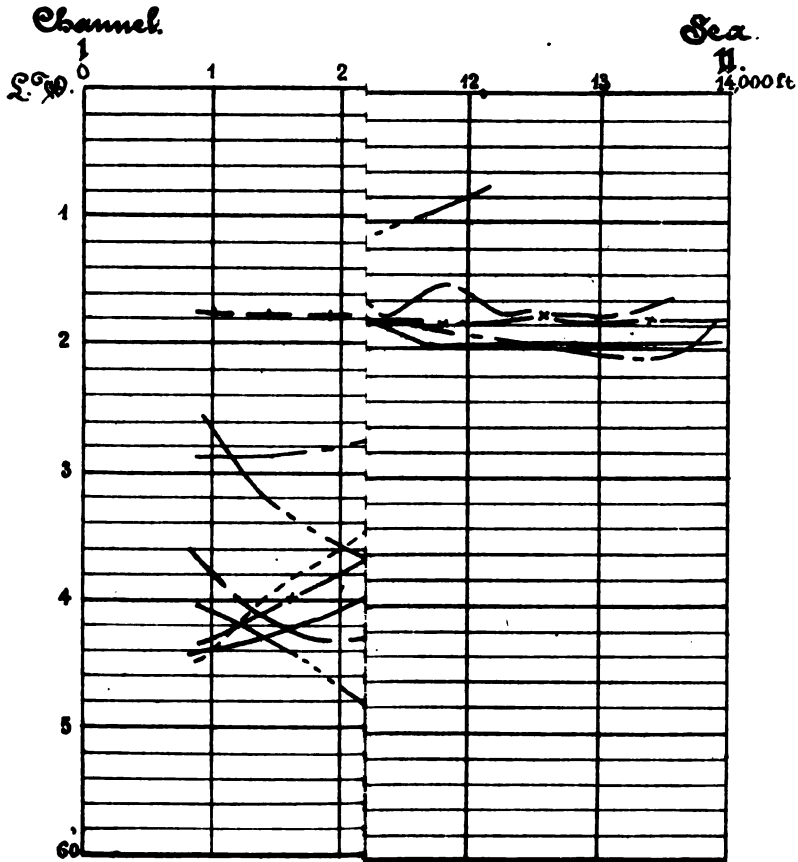
# Slate 24.







# Plate 25.



ANDREW B. GRAHAM PHOTO LITHO WASHINGTON D C

Eng 58 1

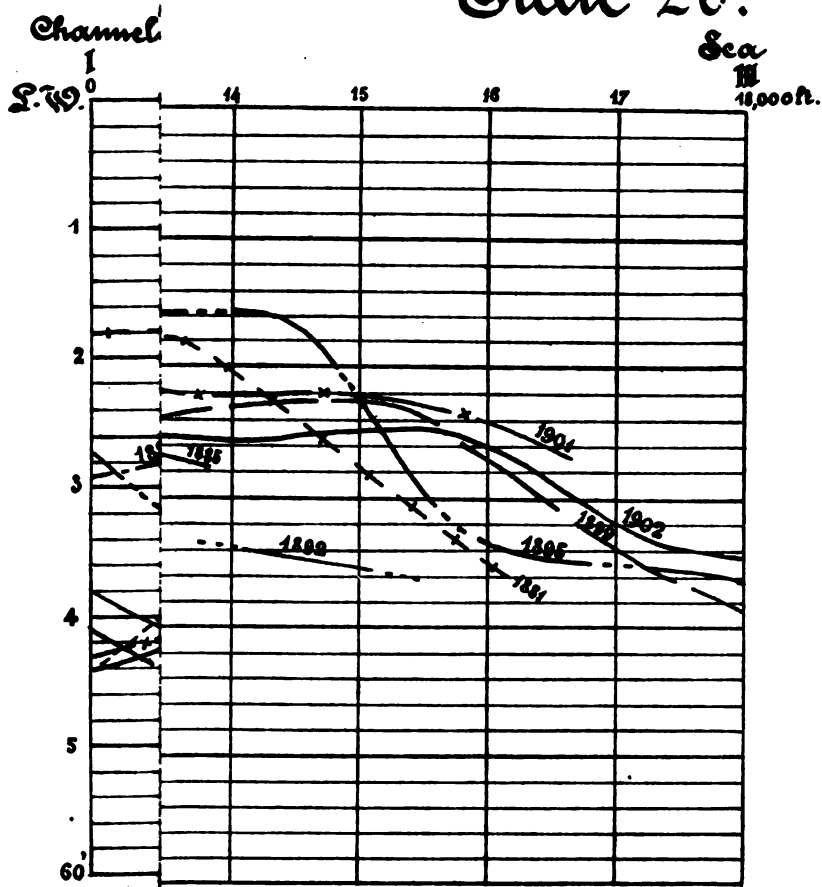
The first part of the document discusses the importance of maintaining accurate records of all transactions. It emphasizes that proper record-keeping is essential for ensuring the integrity of the financial system and for providing a clear audit trail. The document also highlights the need for transparency and accountability in all financial dealings.

In the second part, the focus is on the role of the auditor in verifying the accuracy of the financial statements. The auditor is responsible for examining the records and providing an independent opinion on whether the financial statements are true and fair. This process is crucial for maintaining the confidence of investors and the public in the financial system.

The third part of the document addresses the challenges faced by financial institutions in managing risk. It discusses the various types of risks, such as credit risk, market risk, and operational risk, and provides strategies for identifying, measuring, and mitigating these risks. The document also emphasizes the importance of having a robust risk management framework in place.

Finally, the document concludes by stressing the need for continuous improvement and innovation in the financial sector. It encourages financial institutions to embrace new technologies and to adopt best practices to enhance their efficiency and effectiveness. The document also calls for a strong regulatory environment to ensure the stability and resilience of the financial system.

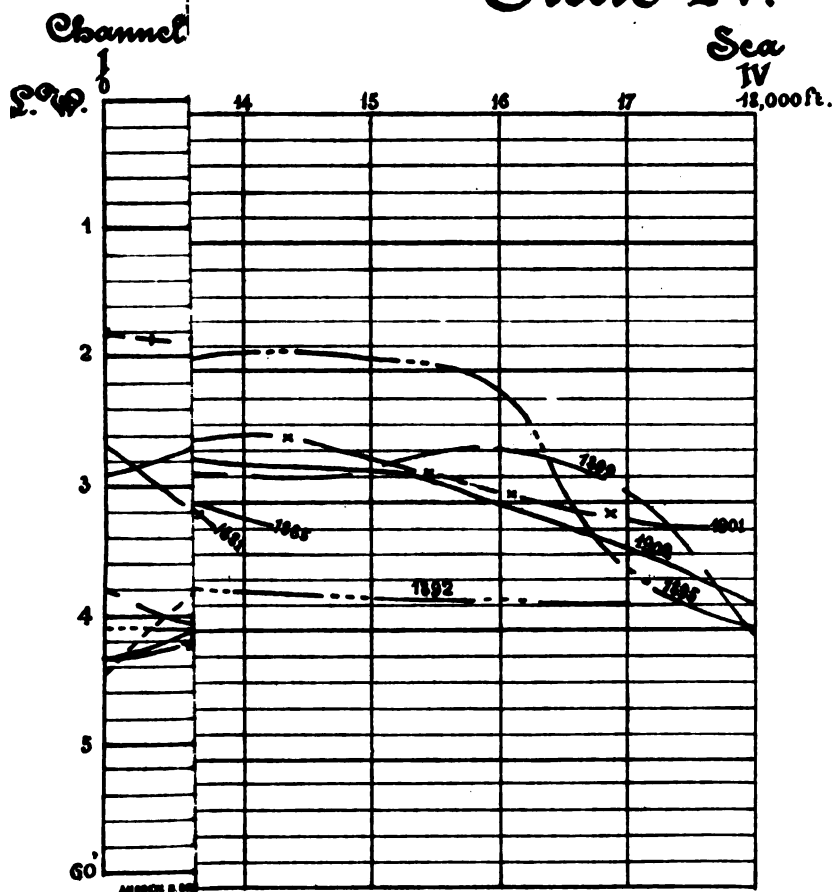
# Slate 26.



Eng 58 1

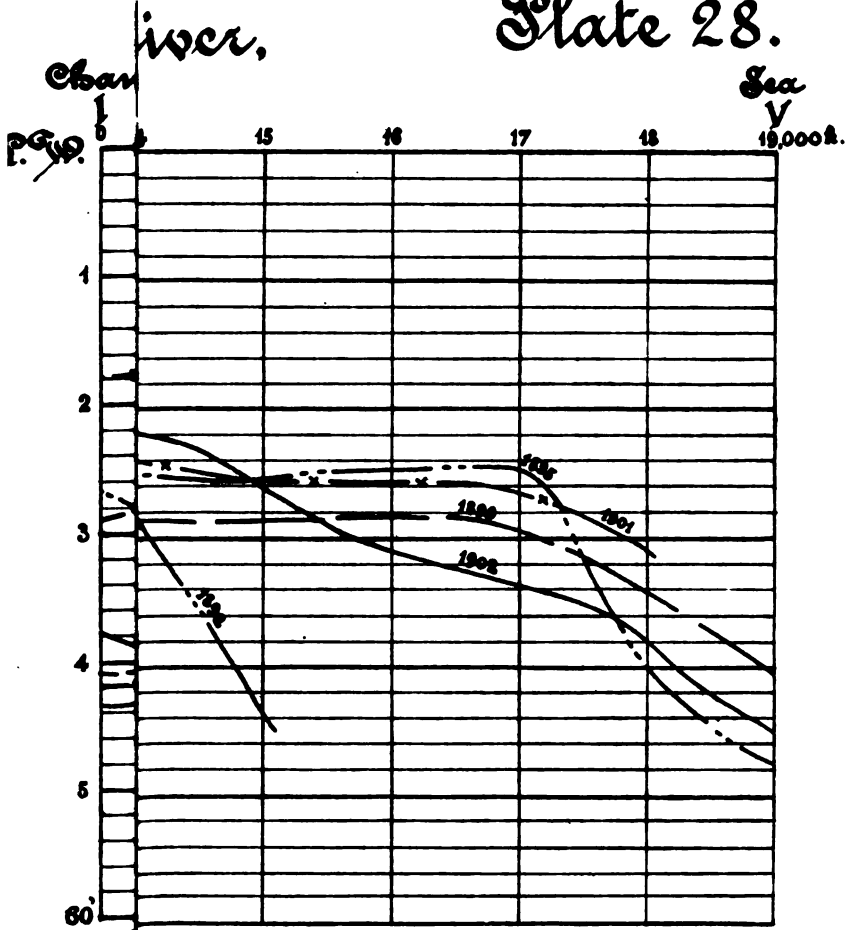


# Slate 27.





# Plate 28.



Eng 58 1





Chai iver,

# Plate 29.

Sea  
VI

L. No.

14

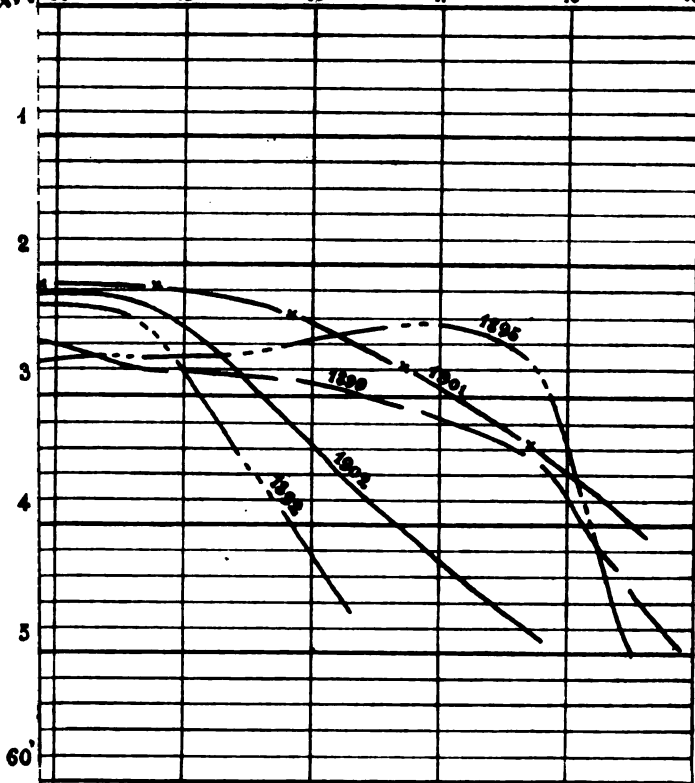
15

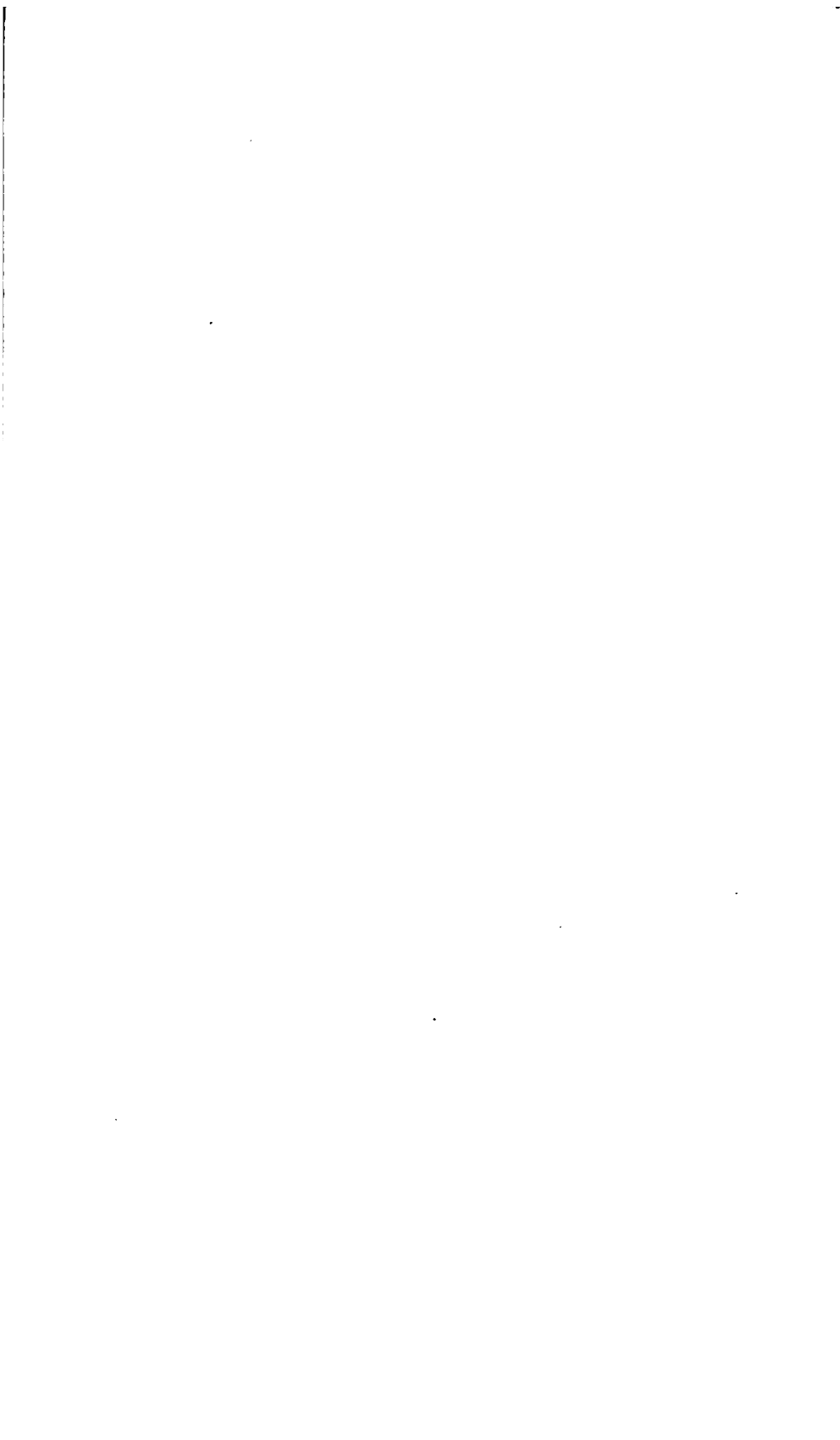
16

17

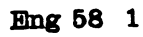
18

19,000 ft.





**18,000 ft**

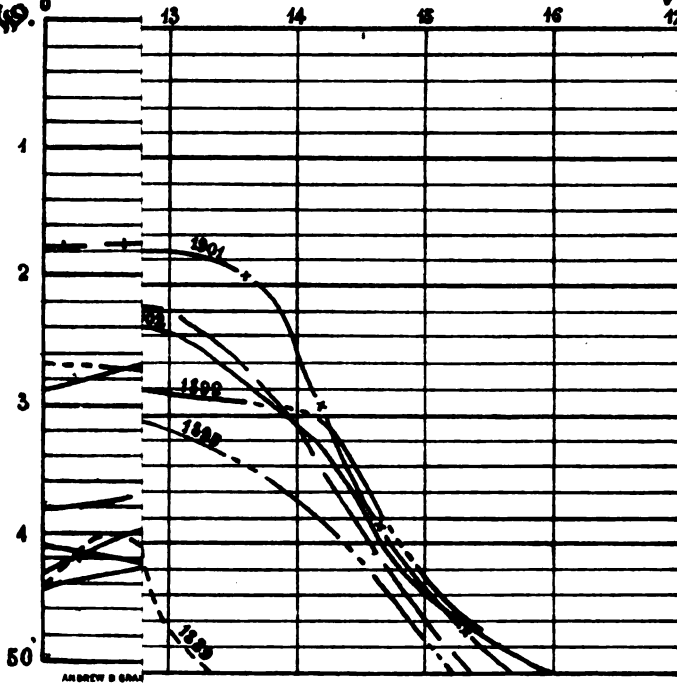




# Slate 31.

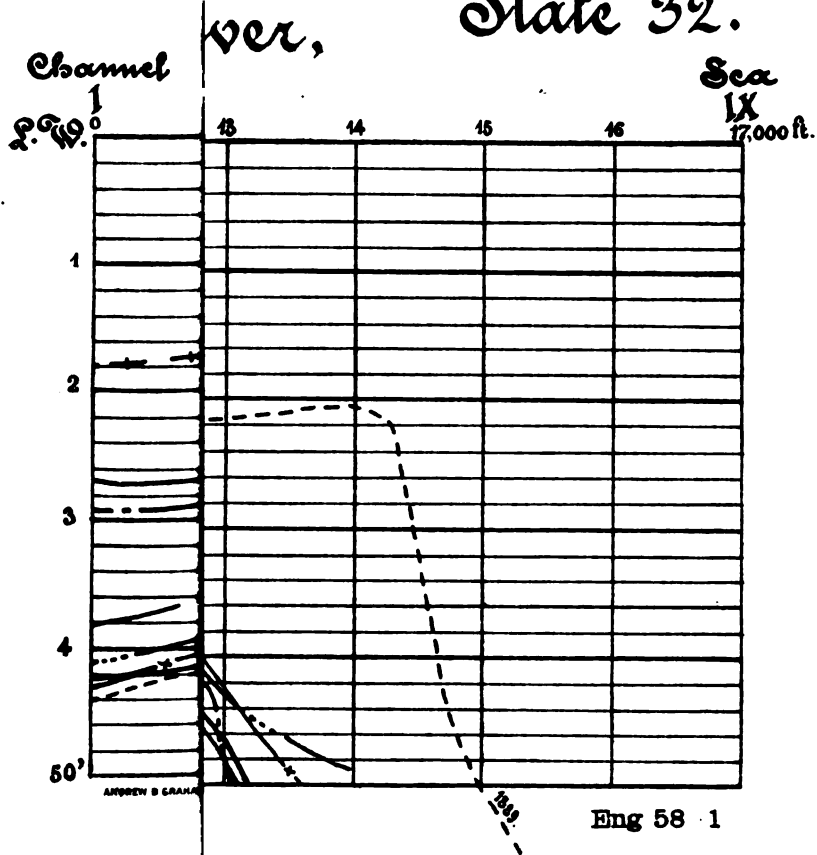
Channel  
p.p. 1  
6

Sea  
VIII.  
17000 ft.





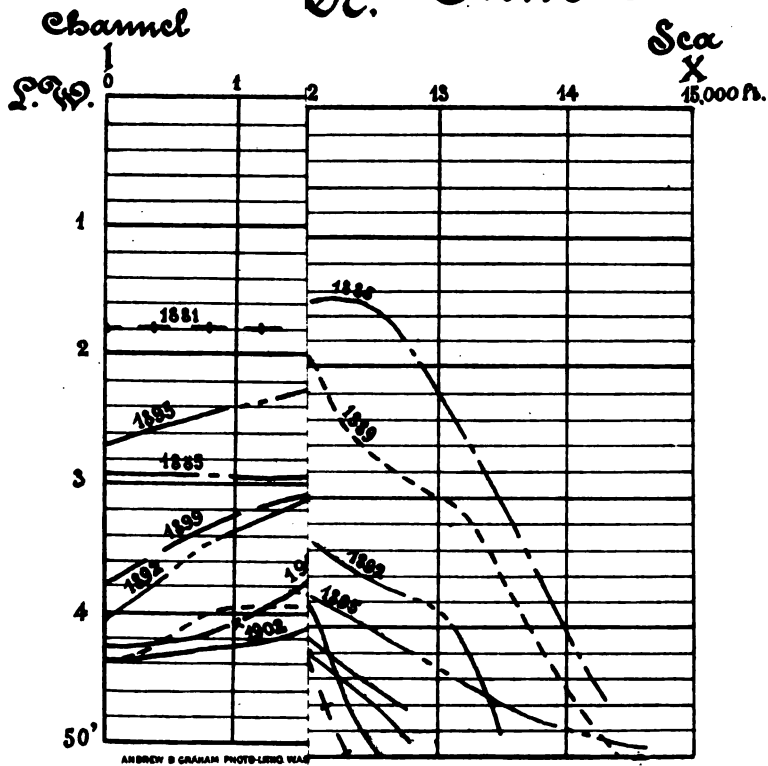
# Plate 32.







# er. Slate 33.

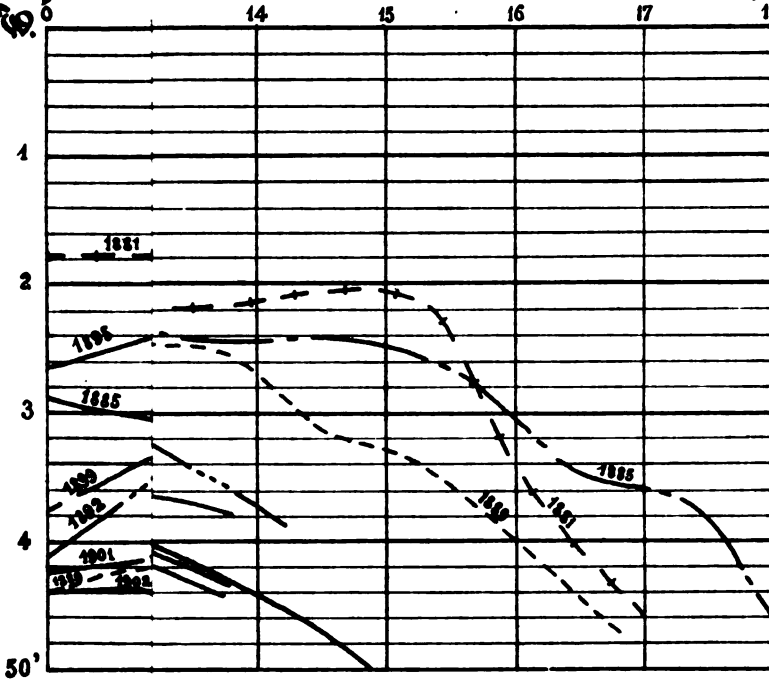




Slate 34.

# Channel

**Sea**



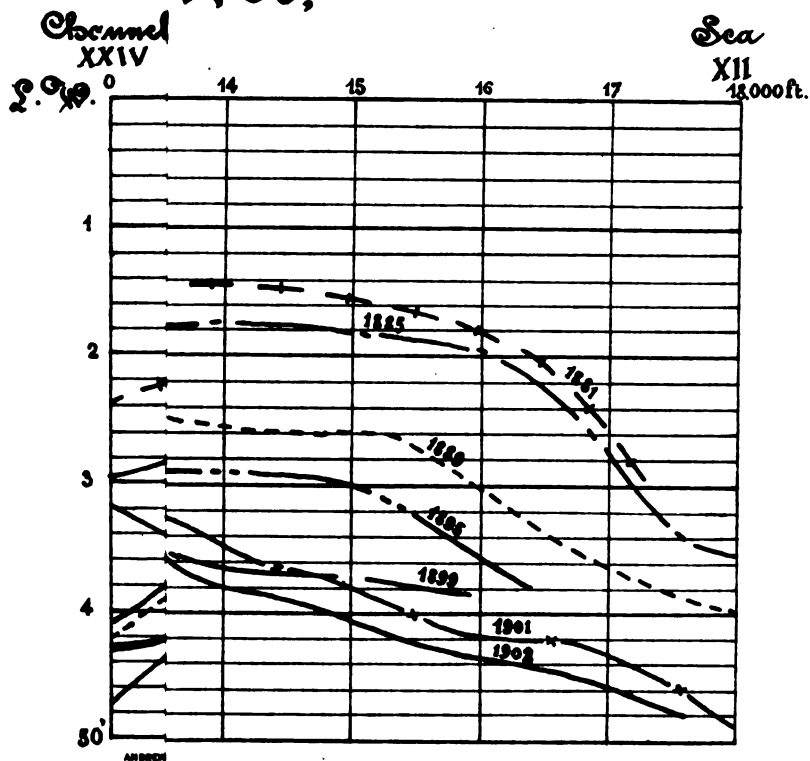
**ANDREW B. GRAM**

**Eng 58 1**



iver,

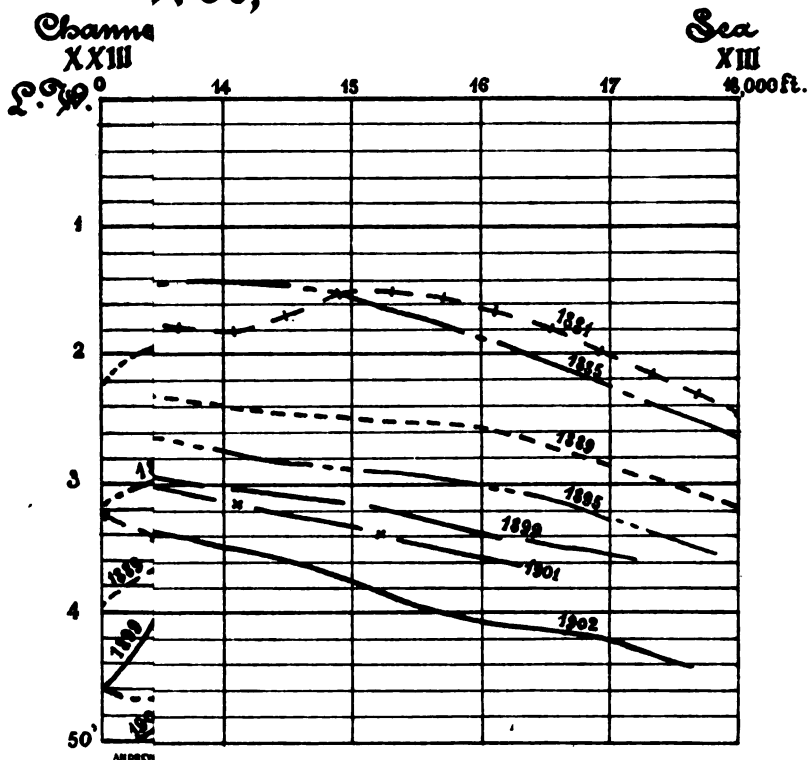
Slate 35.



Eng 58 1



# iver,      Plate 36.



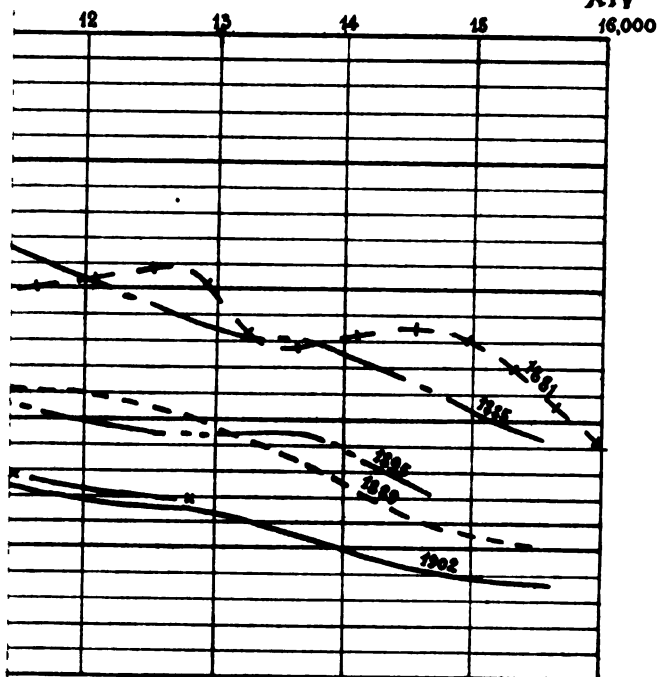
Eng 58 1





# River, Plate 37.

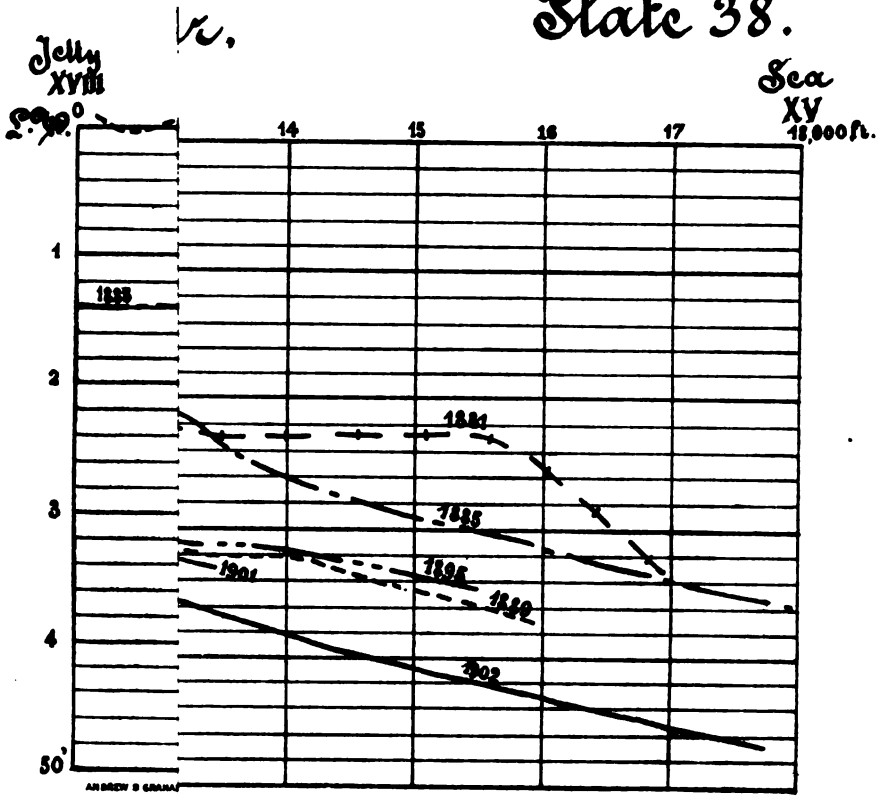
Sea  
XIV



Eng 58 1

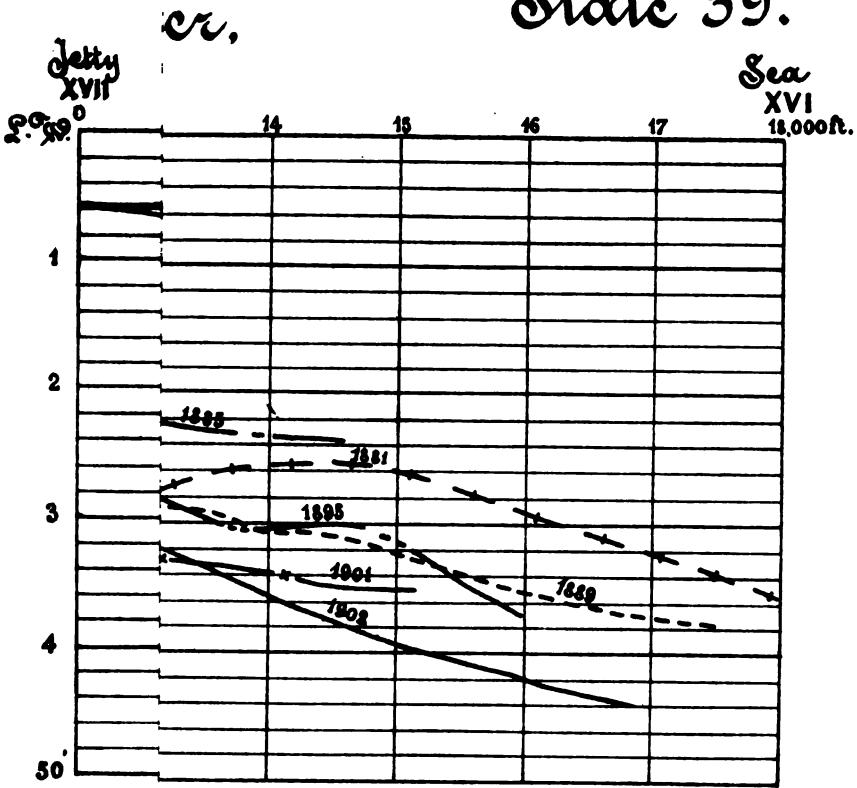


Plate 38.



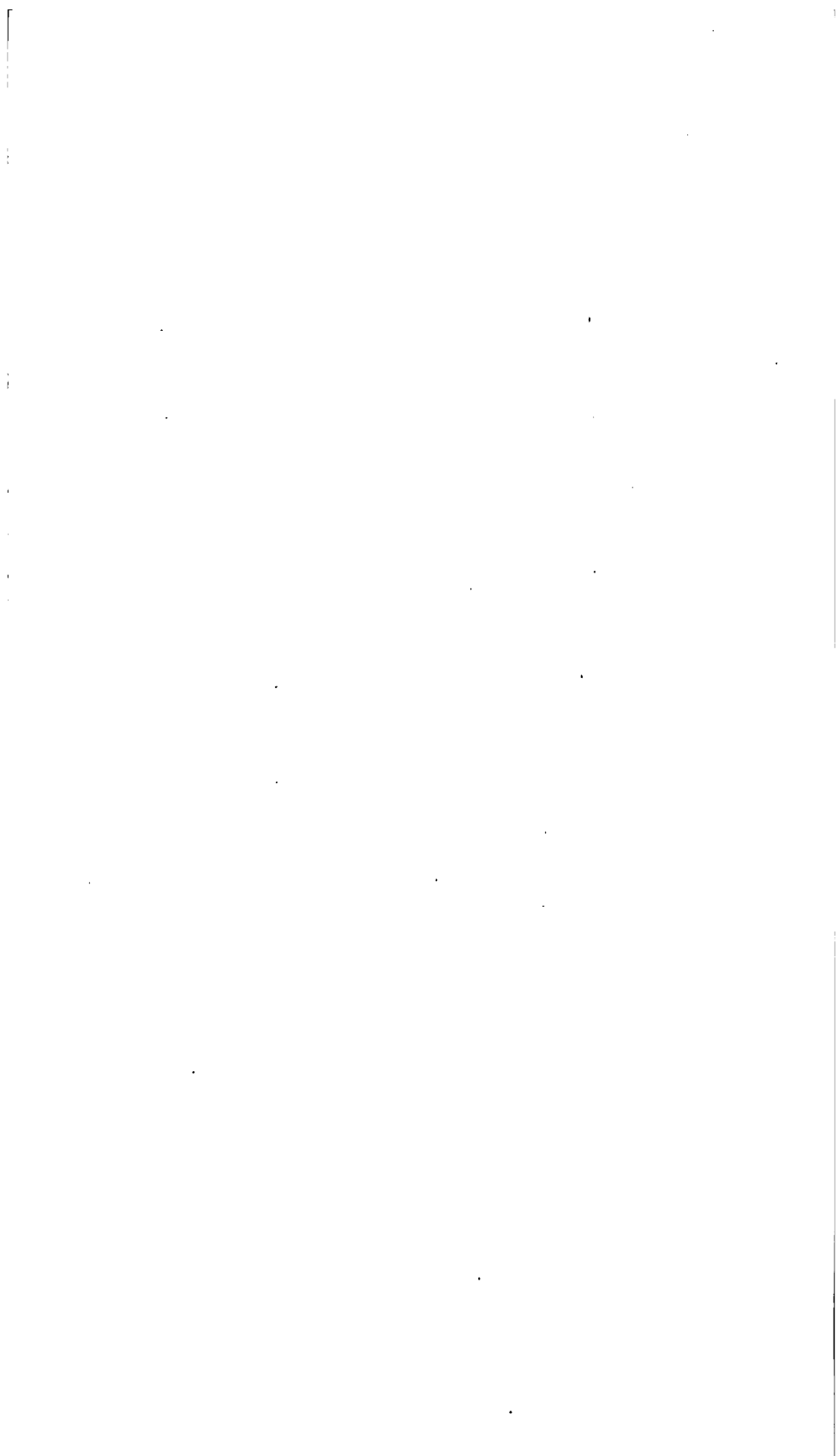


# Plate 39.



ANDREW B. GORR

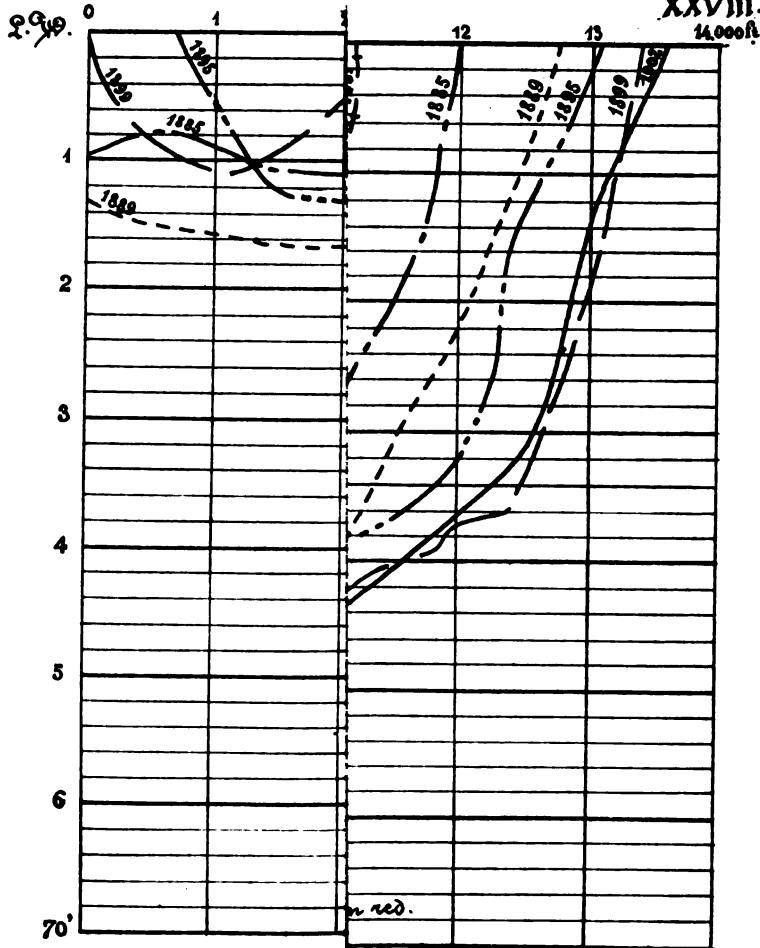
Eng 58 1



Jetty  
Clatsop Spit  
XIX

# River, Plate 40.

Sand Island  
XXVIII.



ANDREW S. GRAMM PHOTO LITHO WASHINGTON D.C.



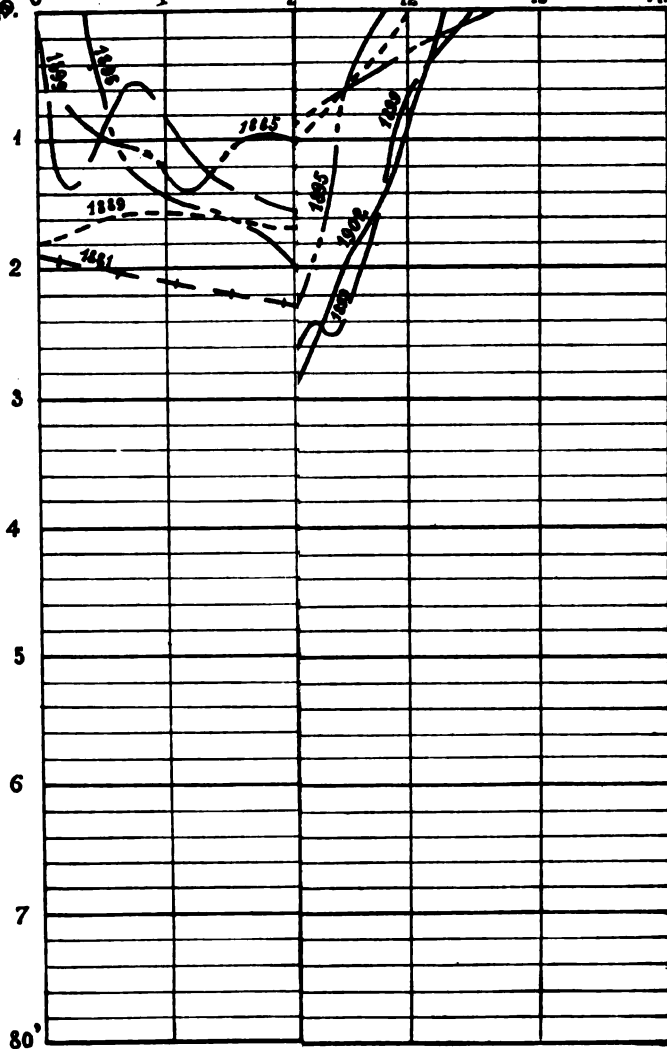


# er. Plate 41.

Jetty  
Clatsop Spit  
XX

Sand Island.  
XXVII.

2. 0 1 2 12 13 14,000 ft



ANDREW B. GRAHAM PHOTO LITHO WASHINGTON

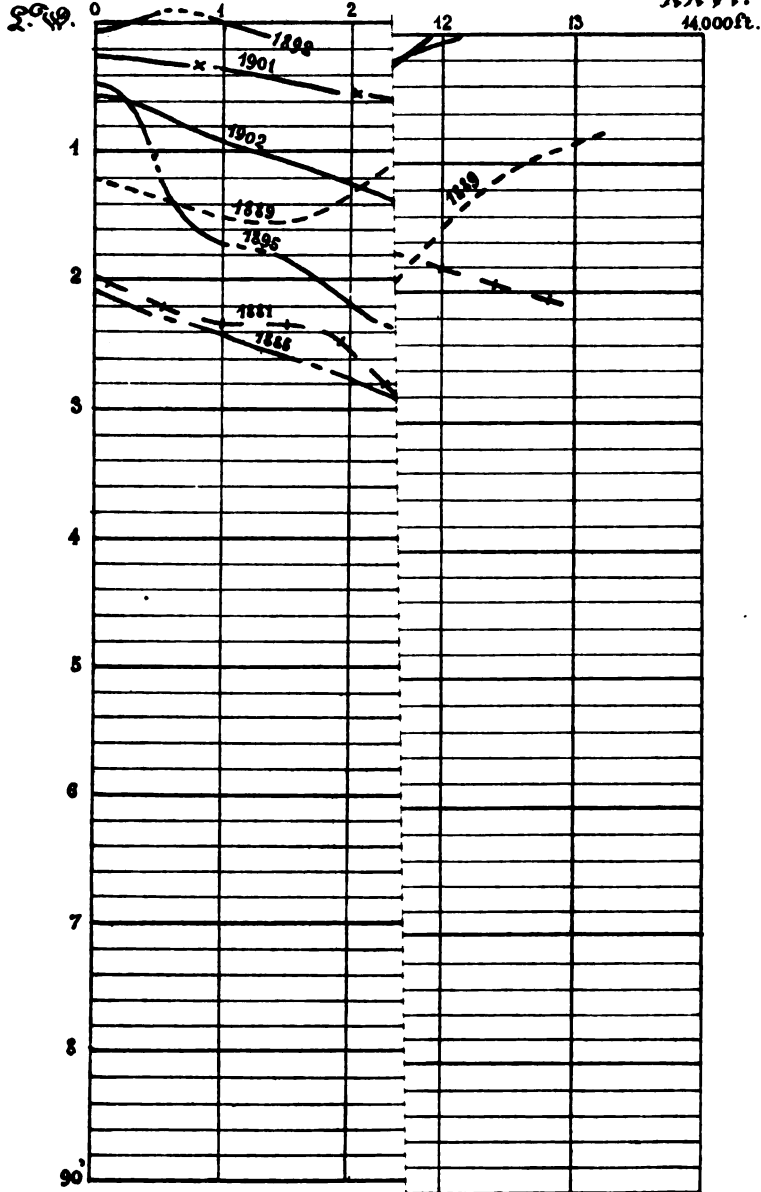
Eng 58 1



# Plate 42.

Jetty  
Clatsop Spit.  
XXI

Seasack Spit.  
XXVI.



ANDREW S. GRAYMAN PHOTO LITHO WASHINGTON D.C.



Slate 43.

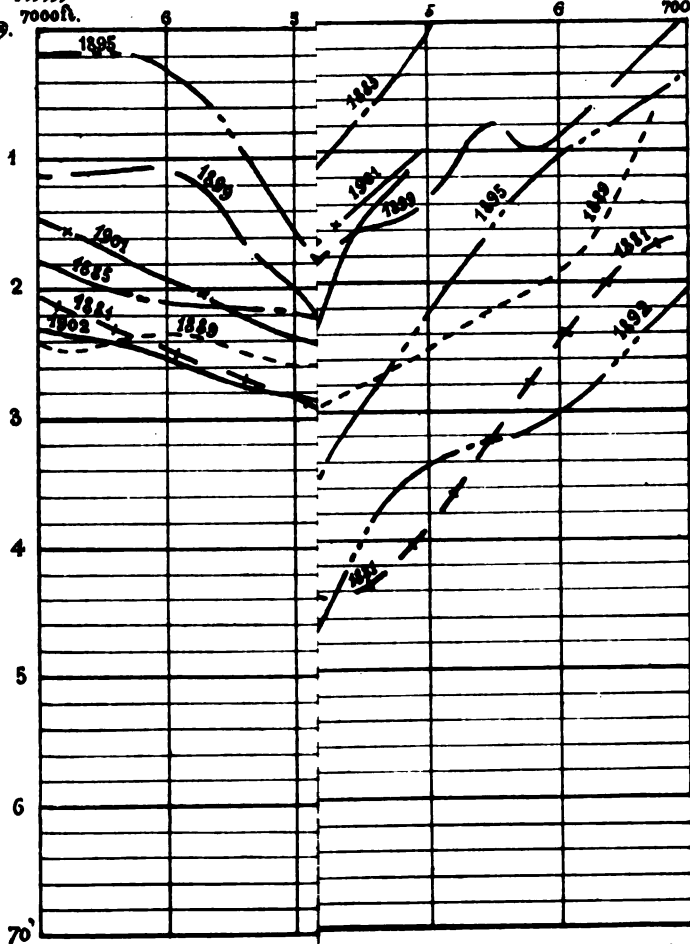


XXII

XXV.

2.49

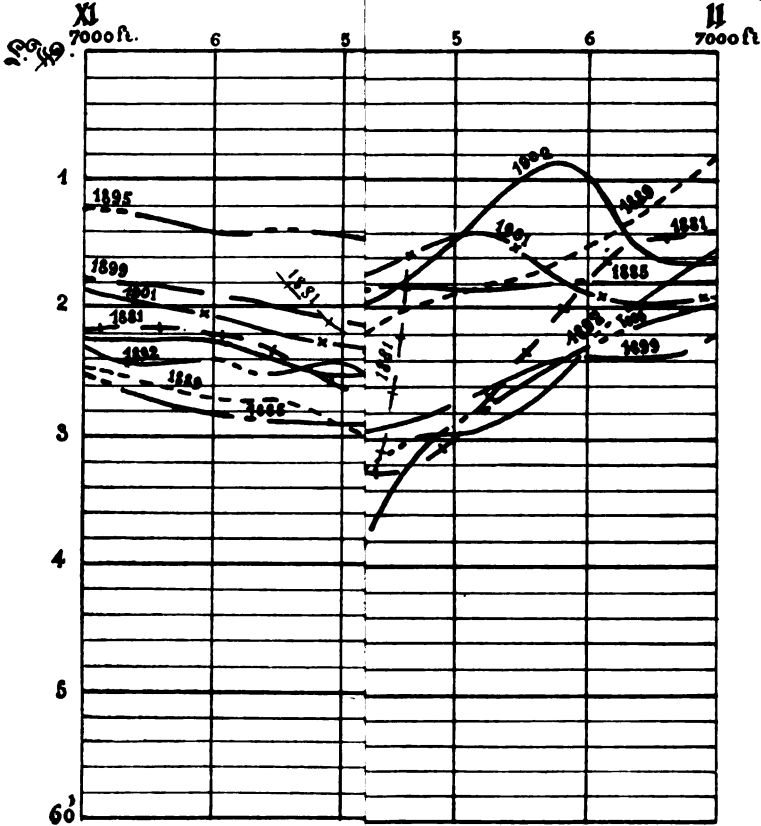
7000 ft



Eng 58 1



५



ANDREW B GRAHAM, PHOTO-LITHO WASHINGTON D C

Eng 58 1





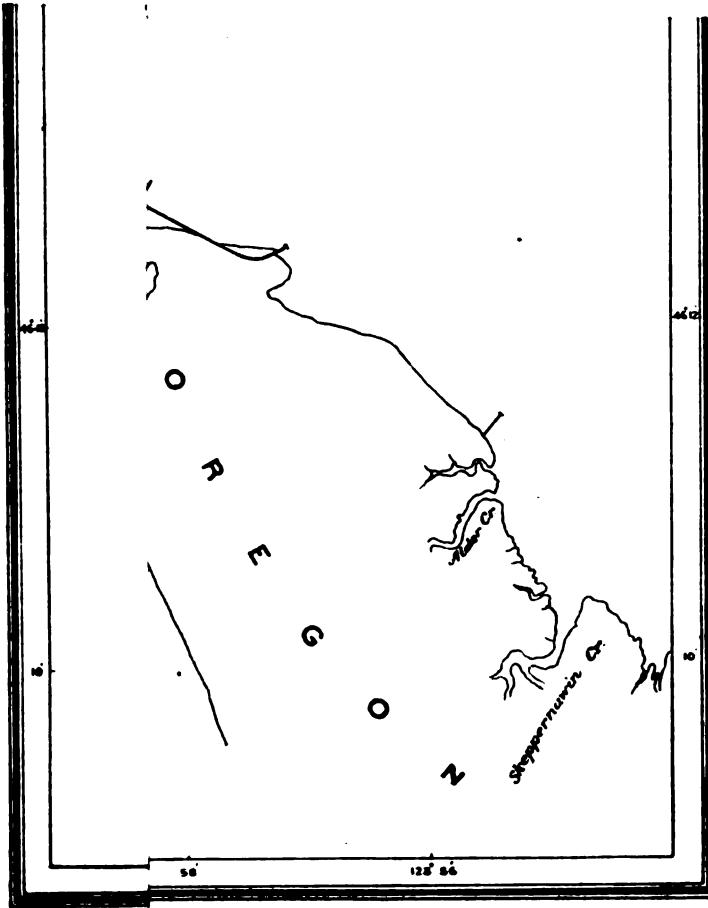




Plate 46.

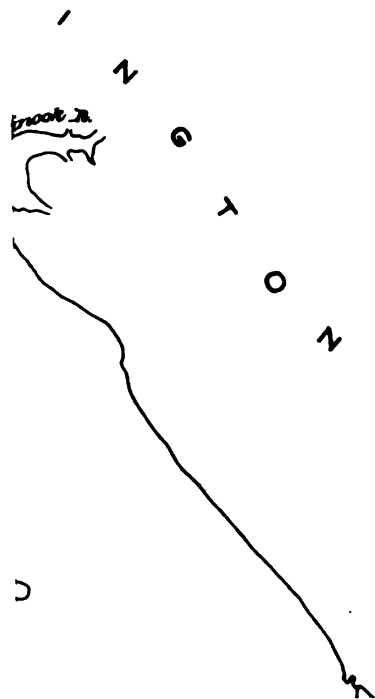




Plate 47.



188

was no remarkable change in the sea slope of the bar itself, although there was a general tendency to recede, most marked near the location of the 1896 channel.

There was no important change in Peacock Spit west of Cape Disappointment. South of the cape the spit continued to build up and toward the sea, particularly at the southwest corner, from which a point of the 18-foot contour extended due west to the channel. Excepting the tendency of Peacock Spit to crowd south into the channel, there was no material change at or west of the gorge.

An appropriation was made and preparations commenced for carrying out the project recommended in 1899 for a 40-foot channel.

1902. *United States Engineer Survey, Assistant Engineer Hegardt.*—A complete survey of the bar, spits, and channel from Fort Stevens to the sea. No survey of Bakers Bay has been made since 1896.

The jetty remained in about the same condition as in previous years. Preparations were continued for resuming work on the improvement under the project prepared in 1899 for a 40-foot channel. An appropriation was made for that purpose and a Board of Engineers appointed.

The old channel had straightened out and swung toward Cape Disappointment, pointing almost north. Its sea end was nearly  $6\frac{1}{2}$  miles from the 1885 location and over 4 miles from the 1890 channel. It had a depth of but 22 feet for width of about 1,000 feet.

The distance between the 30-foot contours at this channel was  $2\frac{1}{2}$  miles, while it was  $1\frac{1}{2}$  miles in the southwest sector of the bar.

With the general deepening of the bar crest two other channels of importance about equal to the remains of the old channel were developed. Of these two channels the first was near the 1895 channel and had a depth of 22 feet. Later reports in the fall of 1902 indicated this channel to be improving in depth. The second channel was near the 1889-90 channels and had a depth of 21 feet.

The Fort Stevens bar had a depth of 34 feet.

There had been a general lowering of the crest of the bar from the jetty to the 1895 channel location. This scour had been most pronounced about 1 mile from the end of the jetty and for 3 miles of this section the conditions were quite similar to those existing in 1885. Between the 1895 and 1901 channel locations there were only slight changes, but between the 1901 channel and Cape Disappointment there had been a considerable fill, averaging 6 or 8 feet on the crest of the bar.

The sea slope of Clatsop Spit from the end of the jetty southward had continued to deepen irregularly beyond the 18-foot depth. The 18-foot contour remained practically the same as in 1895 and 1901, the low-water line remained as in 1901 excepting near the end of the jetty, where it had cut back, and the high-water line remained as in 1901 excepting that it had connected with the Point Adams shore, becoming continuous with it; the Clatsop beach above high water had widened.

The sea slope of the entire bar showed a general tendency to scour, and this tendency was most positive in the southerly sector, notwithstanding the lowering of the crest of the bar.

No material change occurred in Peacock Spit west of the cape, but the southern part of the spit continued to build up and extend to the west, the channel face cutting back slightly. Sand Island and Republic Spit continued to grow toward the west.

## 2318 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

No change occurred in the main channel at the gorge, the conditions at the point being practically identical with those existing in 1899 and 1901 with the exception of a deepening, most pronounced opposite the end of the jetty.

## X X 6.

## IMPROVEMENT OF CLATSKANIE RIVER, OREGON.

## OPERATIONS DURING THE FISCAL YEAR 1903.

No work was done during the fiscal year, the expenditures being for purchase and part payment for a dredge which was bought for use on this stream, if needed, and for dredging for improvement of Cowlitz and Lewis rivers, Washington.

The result of the work of dredging previously done has been very satisfactory, having straightened the channel, thus shortening the distance to head of tide by about 4,500 feet, besides giving about 2 feet more depth.

This stream is worthy of improvement to the extent of maintaining the channel and removing obstructions.

*Money statement.*

July 1, 1902, balance unexpended .....	\$3,081.98
June 30, 1903, amount expended during fiscal year .....	1,425.92
July 1, 1903, balance unexpended .....	1,656.06
{ Amount that can be profitably expended in fiscal year ending June 30, 1905, for maintenance of improvement, in addition to the balance unexpended July 1, 1903 .....	
Submitted in compliance with requirements of sundry civil act of June 4, 1897, and of section 7 of the river and harbor act of 1899.	
	500.00

## APPROPRIATION.

Act of March 8, 1899 .....	\$13,000.00
----------------------------	-------------

## COMMERCIAL STATISTICS.

The following statement of traffic on the Clatskanie River has been compiled from reports of the various steamers and transportation companies doing business on this river during the year ending December 31, 1902:

Articles	Tons	Articles	Tons.
Wheat .....	48	Coal .....	5
Other cereals .....	557	Merchandise .....	612
Flour .....	24	Hay .....	35
Lumber (2,077,406 feet B. M.) .....	2,099	Potatoes .....	78
Piles (81,062 linear feet) .....	121	Fruit .....	8
Shingles .....	12		
Logs (9,418,894 feet B. M.) .....	18,837	Total .....	23,790
Cattle and horses (42) .....	16		
Hops .....	9	Passengers carried .....	1,180
Sheep and hogs (80) .....	8		



## X X 7.

## IMPROVEMENT OF COWLITZ AND LEWIS RIVERS, WASHINGTON.

## (a) OPERATIONS DURING FISCAL YEAR 1903 FOR COWLITZ RIVER, WASHINGTON.

No work was done during the year. The purchase of a dredge was authorized and part payment made from this work, the balance being paid from appropriation for Lewis River, Washington, and Clatskanie River, Oregon.

The dredge was purchased too late to put in commission on this work, as dredging in Lewis River, where she operated, was more urgent.

The results of previous operations are as follows:

The navigable depth has been increased about 4 inches, and while there has been no increase in the width, an improvement equivalent to this has been obtained at different points by the removal of bowlders and other obstructions.

*Money statement.*

July 1, 1902, balance unexpended .....	\$4,750.00
June 30, 1903, amount expended during fiscal year .....	1,458.34
July 1, 1903, balance unexpended .....	3,291.66
July 1, 1903, outstanding liabilities .....	47.00
July 1, 1903, balance available .....	3,244.66
Amount (estimated) required for completion of existing project .....	Indefinite.

## APPROPRIATIONS.

Act of—		Act of—	
June 14, 1880 .....	\$3,000	June 13, 1892 .....	\$3,000
March 3, 1881 .....	1,000	August 18, 1894 .....	3,000
August 2, 1882 .....	1,000	June 3, 1896 .....	3,000
July 5, 1884 .....	2,000	March 3, 1899 .....	3,000
August 5, 1886 .....	2,000	June 13, 1902 (allotted) .....	4,750
August 11, 1888 .....	3,000		
September 19, 1890 .....	3,000	Total .....	35,750

## COMMERCIAL STATISTICS.

The following statement of traffic on the Cowlitz River has been compiled from reports of the various steamers and transportation companies doing business on this river during the year ending December 31, 1902:

Articles.	Tons.	Articles.	Tons.
Wheat, other cereals, and flour .....	3,237	Potatoes .....	3,239
Shingles .....	116	Hops .....	40
Logs (63,455,000 feet B. M.) .....	126,910	Wood (89 cords) .....	133
Cattle and horses (number, 397) .....	153	Piles (23,467 linear feet) .....	469
Sheep and hogs (number, 1,700) .....	127	Total .....	142,842
Merchandise .....	3,253	Passengers carried .....	9,760
Fish .....	280		
Hay .....	4,780		

(b) OPERATIONS DURING FISCAL YEAR 1903 FOR LEWIS RIVER,  
WASHINGTON.

On account of the lack of plant no work was done on the Lewis River until the end of February, when a dipper dredge which was purchased had been repaired and put in commission. The dredge cost \$3,000, with an approximate expenditure of \$500 for repairs, the total cost being divided between appropriations for Lewis, Cowlitz, and Clatskanie rivers.

The dredge commenced operations on February 25 and continued until March 6, when, owing to constant rubbing of the spud chain, she sank. She was raised and repaired and resumed dredging in the East Fork late in March. Operations were suspended on May 11 on account of back water from the Columbia making work impracticable. The dredging operations embraced all the shoal places between the forks and the flume above Kinder rock, and resulted in an increase of about 3 feet in depth over the more troublesome places. The amount of material dredged was 12,960 cubic yards, at a cost of about 10 cents per cubic yard.

During March, April, and May the snag boat *Mathloma* removed 254 snags from the channel between the mouth and the forks, and 1,045 snags were removed from the North Fork up to Woodland.

This work has been of sufficient benefit to warrant further improvement to the extent contemplated.

An index map of the locality under improvement is transmitted herewith.

The amount named in the appended money statement for improvement and maintenance includes the amounts to be expended in construction of controlling works, snagging, and dredging, if deemed advisable, on the Cowlitz and Lewis river improvements.

*Money statement.*

July 1, 1902, balance unexpended .....	\$9,103.2
June 30, 1903, amount expended during fiscal year .....	6,832.3
July 1, 1903, balance unexpended .....	2,270.9
July 1, 1903, outstanding liabilities .....	51.6
July 1, 1903, balance available .....	2,219.4
{ Amount (estimated) required for completion of existing project .....	Indefinite
{ Amount that can be profitably expended in fiscal year ending June 30, 1905, in addition to the balance unexpended July 1, 1903;	
For works of improvement .....	\$10,000.00
For maintenance of improvement .....	5,000.00
	15,000.0
Submitted in compliance with requirements of sundry civil act of June 4, 1897, and of section 7 of the river and harbor act of 1899.	

## APPROPRIATIONS.

Act of March 3, 1899 .....	\$10,000.00
Appropriated by act of Congress approved June 13, 1902, for improving Cowlitz and Lewis rivers, Washington (allotted) .....	4,000.00
Total .....	14,000.00





## COMMERCIAL STATISTICS.

The following statement of traffic on the Lewis River has been compiled from reports of the various steamers and transportation companies doing business on this river during the year ending December 31, 1903:

Articles.	Tons.	Articles.	Tons.
Cereals.....	1,512	Fish.....	187
Logs (671,278 feet B. M.).....	1,842	Hay.....	883
Lumber (21,918,000 feet B. M.).....	28,493	Potatoes.....	2,632
Piles (8,200 linear feet).....	165	Wood (1,042 cords).....	1,563
Cattle and horses (number, 1,104).....	445	Total.....	42,324
Sheep and hogs (number, 1,007).....	75	Passengers carried.....	12,066
Coal.....	23		
Wool.....	27		
Merchandise.....	5,023		

Considerable quantities of timber products are also annually floated out of this stream.

## X X 8.

## GAUGING WATERS OF COLUMBIA RIVER, OREGON AND WASHINGTON.

## OPERATIONS DURING THE FISCAL YEAR 1903.

The self-registering tide gauge at Fort Stevens, Oreg., has been kept in operation during the fiscal year, and, in view of its importance as a benefit to pilots and others interested in navigation, is considered a worthy object.

The amount expended during the fiscal year was for hire of gauge keeper.

*Money statement.*

July 1, 1903, balance unexpended.....	\$1,597.79
June 30, 1903, amount expended during fiscal year.....	190.00
July 1, 1903, balance unexpended.....	1,407.79
{ Amount that can be profitably expended in fiscal year ending June 30, 1905, for maintenance of improvement, in addition to the balance unexpended July 1, 1903 .....	
Submitted in compliance with requirements of sundry civil act of June 4, 1897, and of section 7 of the river and harbor act of 1899.	
	1,000.00

## APPROPRIATIONS.

Act of—	Act of—
August 2, 1882..... \$500	June 3, 1896..... \$1,000
July 5, 1884..... 1,000	March 3, 1899..... 1,000
August 5, 1886..... 1,000	June 13, 1902..... 1,000
August 11, 1888..... 2,500	Total..... 9,000
August 18, 1894..... 1,000	



## APPENDIX Y Y.

### IMPROVEMENT OF CERTAIN RIVERS AND HARBORS IN WASHINGTON.

REPORT OF MAJ. JOHN MILLIS, CORPS OF ENGINEERS, OFFICER IN  
CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1903, WITH  
OTHER DOCUMENTS RELATING TO THE WORKS.

#### IMPROVEMENTS.

- |   |   |
|---|---|
| 1. Willapa River and Harbor, Wash-<br>ington.   | 5. Harbor at Olympia, Washington.   |
| 2. Grays Harbor and bar entrance,<br>Washington.  | 6. Tacoma Harbor, Washington.   |
| 3. Grays Harbor, inner portion, between<br>Aberdeen and the entrance to said<br>harbor and Chehalis River, Wash-<br>ington. | 7. Waterway connecting Puget Sound<br>with Lakes Union and Washing-<br>ton, Washington. |
| 4. Puget Sound and its tributary waters,<br>Washington.   | 8. Everett Harbor, Washington.  |
|   | 9. Swinomish Slough, Washington.  |
|   | 10. New Whatcom Harbor, Washington.   |
|   | 11. Okanogan and Pend Oreille rivers,<br>Washington.                                    |

#### SURVEY.

12. Canal connecting Puget Sound with Lakes Union and Washington, Washington.

UNITED STATES ENGINEER OFFICE,  
*Seattle, Wash., July 30, 1903.*

GENERAL: I have the honor to forward herewith \* \* \* annual  
reports of the river and harbor works in my charge for the fiscal year  
ending June 30, 1903.

Very respectfully, your obedient servant,

JOHN MILLIS,  
*Major, Corps of Engineers.*

Brig. Gen. G. L. GILLESPIE,  
*Chief of Engineers, U. S. A.*

#### Y Y 1.

### IMPROVEMENT OF WILLAPA RIVER AND HARBOR, WASHINGTON.

Under the authority of the act of June 13, 1902, and the project  
approved November 19, 1902, the balance available is to be expended  
in repair and maintenance of existing work and in snagging and other-  
wise improving the North and Nasel rivers.

## 2324 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

The Mailboat Slough dike was repaired and refilled and the Loud-erback Slough dike was partly removed to enlarge the opening in it to a width of 43 feet for the accommodation of vessels. The work was done by an informal contract at a contract cost of \$686.39.

Examinations were made of both the North and Nasel rivers, but no work was done on these streams. The improvement of the former to be effective would cost more than the amount available. A small amount of work on the Nasel is to be done at an early date.

The work was in local charge of Mr. C. E. Hansen, overseer, at the close of the year.

### *Money statement.*

July 1, 1902, balance unexpended.....	\$4,198.94
June 30, 1903, amount expended during fiscal year .....	1,490.98
July 1, 1903, balance unexpended.....	2,707.96
Amount that can be profitably expended in fiscal year ending June 30, 1905, for maintenance of improvement, in addition to the balance unexpended July 1, 1903.....	
Submitted in compliance with requirements of sundry civil act of June 4, 1897, and of section 7 of the river and harbor act of 1899.	<sup>a</sup> 5,000.00

### APPROPRIATIONS.

Act of—	
July 13, 1892.....	\$18,000
August 18, 1894 .....	13,350
March 3, 1899.....	5,000
Total.....	36,350

### COMMERCIAL STATISTICS.

#### *Shipping.*

	Coastwise.		Foreign.	
	Arrived.	Departed.	Arrived.	Departed.
Steam vessels .....	13	13		
Sail vessels.....	43	39		

The maximum draft of vessels was 19 feet.

#### *Exports and imports.*

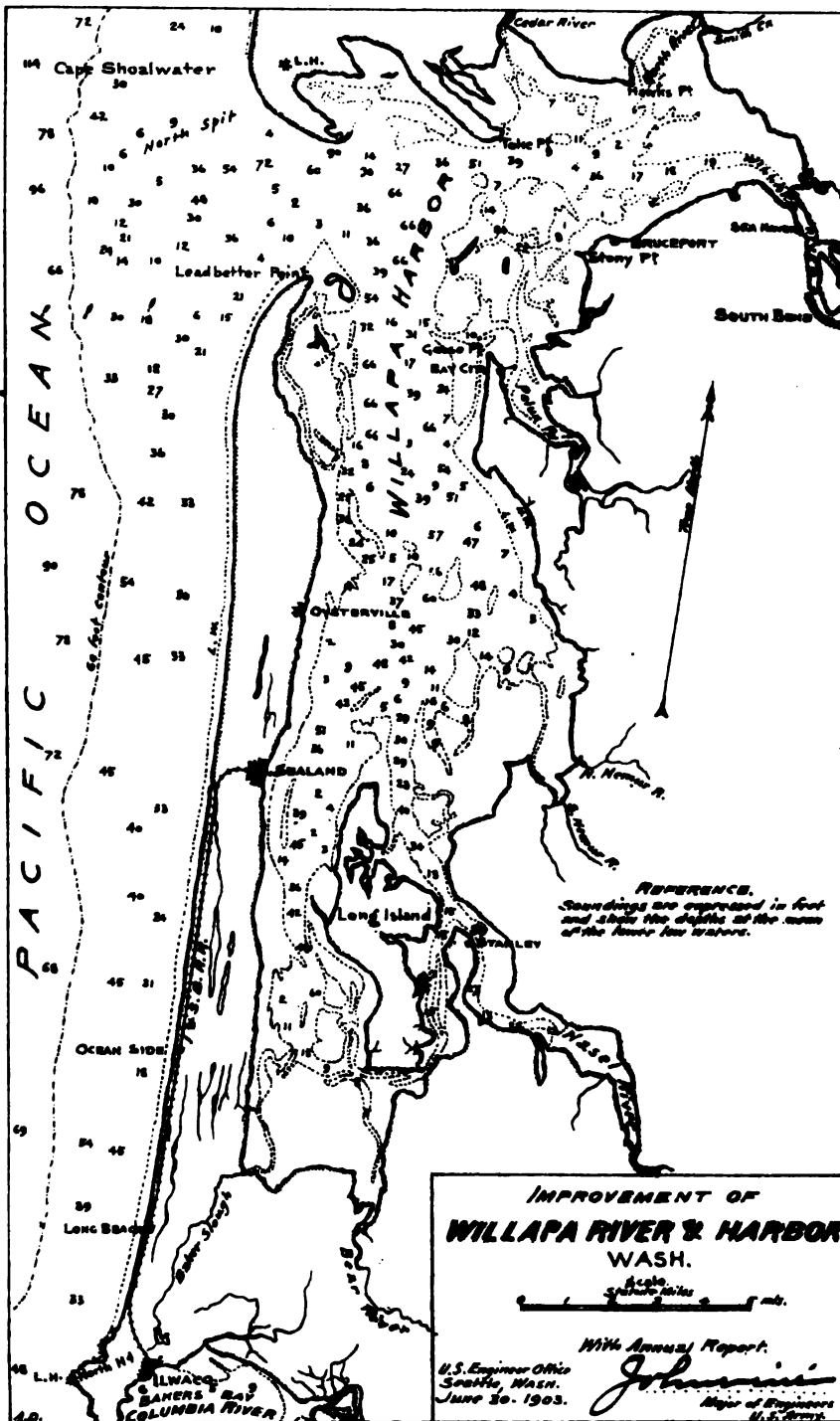
Articles.	Exports.		Imports.	
	Quantity.	Value.	Quantity.	Value.
Lumber and products .....	Tons.		Tons.	
Shellfish.....	51,224	\$277,050		
Miscellaneous merchandise .....	350	15,000		
Total .....			425	\$110,000
	51,574	292,050	425	110,000

Four steamers and two launches, with an aggregate gross tonnage of 325 tons and maximum draft of 13 feet, were engaged in local traffic.

Fifty-seven million feet, B. M., of saw logs were rafted and towed to the mills on the harbor and to Nahcotta for shipment by rail.

<sup>a</sup>The full amount for improvement as heretofore authorized by Congress has been appropriated.





THE WASHINGTON STATE ENGINEERING SOCIETY, WASHINGTON, D. C.



## Y Y 2.

IMPROVEMENT OF GRAY'S HARBOR AND BAR ENTRANCE,  
WASHINGTON.

Construction work proper was actively prosecuted under the contract with the Hale & Kern Contract Company from the beginning of the year until the limit of cost under the law was reached.

Operations consisted of extension of the jetty as far as funds would allow and the repairing and storing of a part of the plant used in the construction of the jetty by the Hale & Kern Contract Company, which was purchased by the Government.

The work of building the jetty continued from July 1 to September 15, when it was discontinued. During this time the trestle was extended from bent 1120 to bent 1165, a distance of 720 feet.

The depth of water met with in advancing the trestle varied from 8 feet to 20 feet. The length of piles varied from 58 feet to 70 feet and the penetration from 16 feet to 24 feet.

The brush foundation was advanced from bent 1120+4 to bent 1165+8, a distance of 724 feet. The depth of water into which the mattresses were sunk varied from 16 feet to 20 feet and the scour from the time of driving the piles until the mattresses were in place varied from 0 feet to 9 feet, the average being about 3 feet.

When work was closed down on September 15 the enrockment was practically completed to the level of ordinary high tide to bent 1160, a distance of 13,704 feet outside the ocean high water line, and from bent 1160 to the end of the jetty, a distance of 80 feet; the height of the enrockment averaged about 1 foot below ordinary high tide. The last 96 feet of the jetty was double enrocked to an elevation of 1 foot above mean lower low water.

The groin at right angles to the jetty on the north side at bent 1050, the construction of which was begun October 21, 1901, was completed August 8, 1902. The end of the groin is 508 feet north of the jetty.

The advance for the year was as follows:

	Feet.
Trestle advanced .....	720
Foundation advanced .....	724
Completed enrockment advanced .....	880

The total length of the jetty outside the high-water line on the ocean side of the spit on the discontinuance of work September 15, 1902, was 13,784 feet.

When work was shut down on September 15 the steel rails and foot planks likely to be carried away by the sea were taken up and stored on the wharf. The plant and buildings were put in shape to be cared for by a watchman, and the assistant in local charge was relieved and stationed at Hoquiam in December.

The first winter storms carried away practically all of the trestle west of bent 950 with the exception of the groin trestle, which appears to be intact, or nearly so. There are six breaks in the trestle east of bent 950, varying in length from 48 feet to 256 feet. There are also a great many single piles gone. The enrockment appears to have settled considerably west of bent 1020—11,468 feet west of the ocean high-water line—but stone is in sight at extreme low tide clear to the end of the jetty.

## 2326 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

A survey of the bar and entrance was begun in June and has not yet been completed. The indications are that the best channel depth is about a foot less than it was last year.

Appropriations have already been made to the limit of cost heretofore authorized by Congress. Under instructions from the Chief of Engineers a revision of the project and estimates for completing the work are now in preparation.

The work was in local charge of E. L. Carpenter, junior engineer, at the close of the year.

### *Money statement.*

July 1, 1902, balance unexpended.....	\$164,121.10
June 30, 1903, amount expended during fiscal year.....	159,786.23
July 1, 1903, balance unexpended.....	4,334.88
July 1, 1903, outstanding liabilities.....	149.33
July 1, 1903, balance available.....	4,185.55
{ Amount that can be profitably expended in fiscal year ending June 30, 1905, for maintenance of improvement, in addition to the balance unexpended July 1, 1903 .....	
Submitted in compliance with requirements of sundry civil act of June 4, 1897, and of section 7 of the river and harbor act of 1899.	
	30,000.00

### APPROPRIATIONS.

Act of—		Act of—	
June 3, 1896 .....	\$20,000	March 3, 1901.....	\$138,225
June 4, 1897 .....	350,000	June 28, 1902 .....	156,775
March 3, 1899.....	285,000		
June 6, 1900 .....	50,000	Total.....	1,000,000

### CONTRACT IN FORCE DURING FISCAL YEAR.

Contractors: The Hale & Kern Contract Company.

Date of contract: January 26, 1898.

Date of approval: February 23, 1898.

Date of commencement: May 1, 1898.

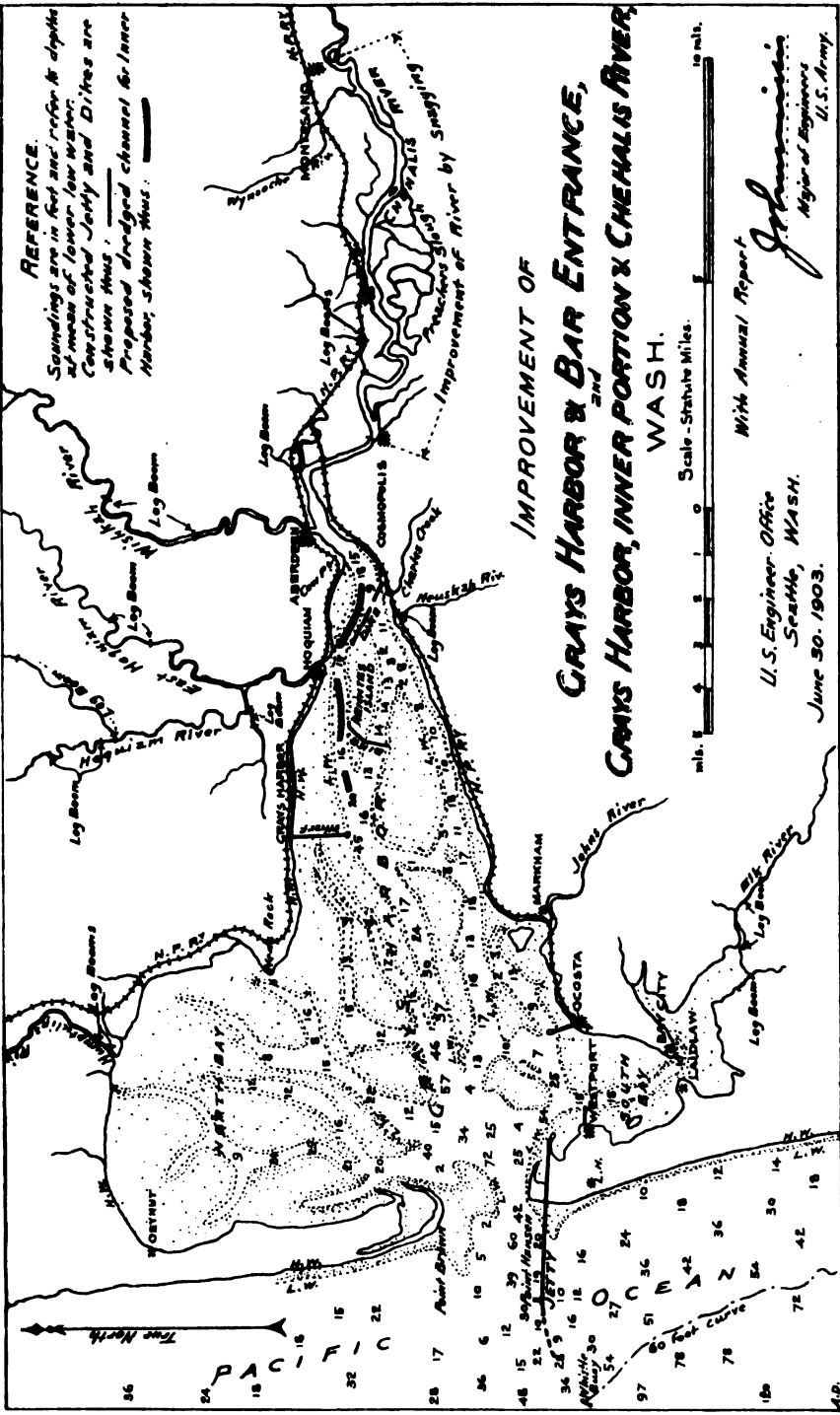
Contract completed: September 24, 1902.

### COMMERCIAL STATISTICS.

#### *Shipping.*

	Arrived.	Departed.
Steam vessels .....	230	231
Sail vessels .....	150	155

Maximum draft of vessels, 19 feet 11 inches.  
Number of passengers carried, 3,774.



**REFERENCE.**  
 Soundings are in feet and refer to depths  
 at mean of lower low water.  
 Constructed Jetty and Dikes are  
 shown thus: ————  
 Proposed dredged channel & Inner  
 Harbor, shown thus: ————

# IMPROVEMENT OF GRAYS HARBOR & BAR ENTRANCE, and GRAYS HARBOR, INNER PORTION & CHEHALIS RIVER, WASH.

Scale - Statute Miles.  
 0 1 2 3 4 5 6 7 8 9 10  
 0 1 2 3 4 5 6 7 8 9 10  
 0 1 2 3 4 5 6 7 8 9 10  
 0 1 2 3 4 5 6 7 8 9 10

With Annual Report  
 U.S. Engineer Office  
 Seattle, Wash.  
 June 30, 1903.

*John H. ...*  
 Major of Engineers  
 U.S. Army.



*Exports and imports.*

Articles.	Exports.		Imports.	
	Quantity.	Value.	Quantity.	Value.
	<i>Tons.</i>		<i>Tons.</i>	
Lumber products.....	518,142	\$2,868,171		
Coal.....			1,060	\$15,700
Miscellaneous merchandise.....	333	26,000	7,512	681,292
Total.....	518,475	2,894,171	8,572	706,992

Five sail vessels and four steam vessels, with an aggregate gross tonnage of 3,104 tons, were constructed at yards on Grays Harbor during the year.

The construction of five new sawmills was begun during the year.

## Y Y 3.

## IMPROVEMENT OF GRAYS HARBOR, INNER PORTION, BETWEEN ABERDEEN AND THE ENTRANCE TO SAID HARBOR, AND CHEHALIS RIVER, WASHINGTON.

The general project approved November 5, 1902, contemplates dredging a channel through the shoals near Aberdeen and Hoquiam, snagging and clearing obstructions from the Chehalis River and repairing the dikes.

The operations for the year consisted of a survey of inner Grays Harbor and Chehalis River between Aberdeen and Old Grays Harbor city dock and of the location of the proposed dredged channel of the inner harbor, and of surveys of the water fronts of Aberdeen and Hoquiam for the purpose of relocating and readjusting the harbor lines in front of these two cities.

The detailed plans, estimate, and specifications for the proposed dredging were nearly completed at the close of the year. There was some difficulty in adjusting the proposed dredged channel on account of interests not altogether in harmony as to details of location.

In the Chehalis River snagging operations were carried on with a hired plant and good results were obtained. Eighty-one snags and a large amount of small debris were removed.

The work was in local charge of E. L. Carpenter, Junior Engineer, at the close of the year.

*Money statement.*

July 1, 1902, balance unexpended.....	\$51,870.59
June 30, 1903, amount expended during fiscal year.....	2,565.48
July 1, 1903, balance unexpended.....	49,305.11
July 1, 1903, outstanding liabilities.....	260.00
July 1, 1903, balance available.....	49,045.11
(Amount (estimated) required for completion of existing project.....	50,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1905, in addition to the balance unexpended July 1, 1903.....	50,000.00
Submitted in compliance with requirements of sundry civil act of June 4, 1897.	

# 2328 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

## APPROPRIATIONS.

*Improvement of Grays Harbor, inner portion, between Aberdeen and the entrance to said harbor, and Chehalis River, Washington.*

Act of July 18, 1892.....	\$50,000
Act of August 17, 1894.....	25,000
Act of June 18, 1902.....	50,000
Total.....	125,000

### *Improvement of Chehalis River, Washington.*

Act of—		Act of—	
August 2, 1883.....	\$3,000	June 3, 1896.....	\$3,000
July 5, 1884.....	2,500	March 3, 1899.....	3,000
August 5, 1886.....	2,500		
August 11, 1888.....	2,000	Total.....	19,000
September 19, 1890.....	3,000		

## COMMERCIAL STATISTICS.

### *Exports and imports.*

[Local traffic.]

Articles.	Quantity.	Value.
	Tons.	
Fish.....	716	\$25,812
Lime.....	1,002	11,222
Miscellaneous merchandise.....	1,811	110,498
Total.....	3,529	147,532

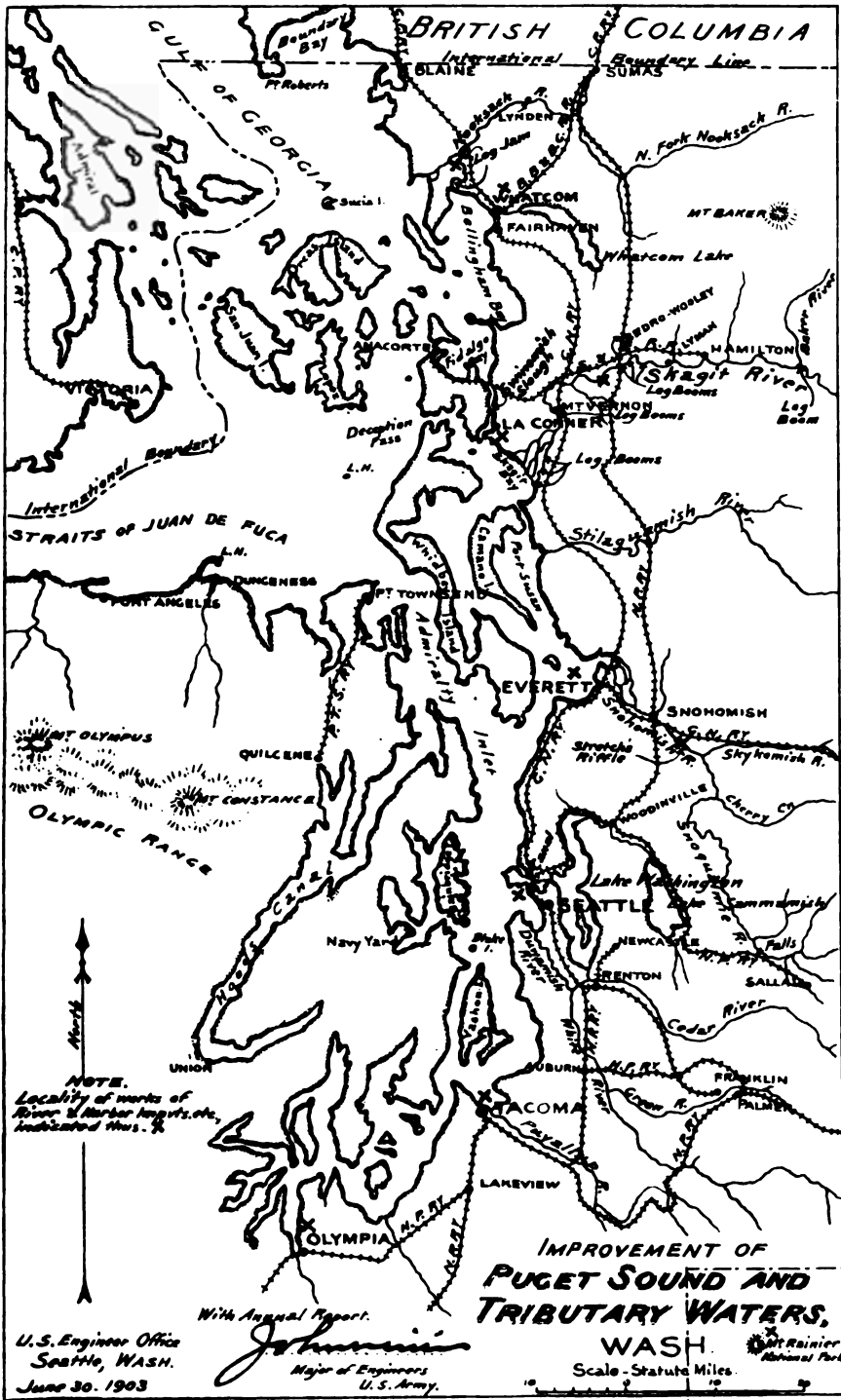
Fourteen steam vessels and 11 launches, with an aggregate gross tonnage of 1,199 tons and maximum draft of 10 feet, were engaged in local traffic. Number of passengers carried, 13,475. Two hundred and sixty-two million seven hundred and seventy-two thousand feet B. M. of saw logs were towed to the mills on Grays Harbor during the year.

## Y Y 4.

### IMPROVEMENT OF PUGET SOUND AND ITS TRIBUTARY WATERS, WASHINGTON.

The snag boat *Skagit* worked continuously throughout the year, with short interruptions for repairs and during high-water season. The streams worked on were the Skagit, including North Fork and Tom Moore Slough, Snohomish, Skykomish, Snoqualmie, and Stillaguamish rivers, Hat Slough and Swinomish Slough. Trips of inspection and for examination and tests of drawbridges were also made. The work was of the usual character—removing snags and jams of logs and cutting trees and brush on the banks. The snag boat also assisted in the removal of a wrecked freight train from the Skagit River at the railroad bridge near Mount Vernon.

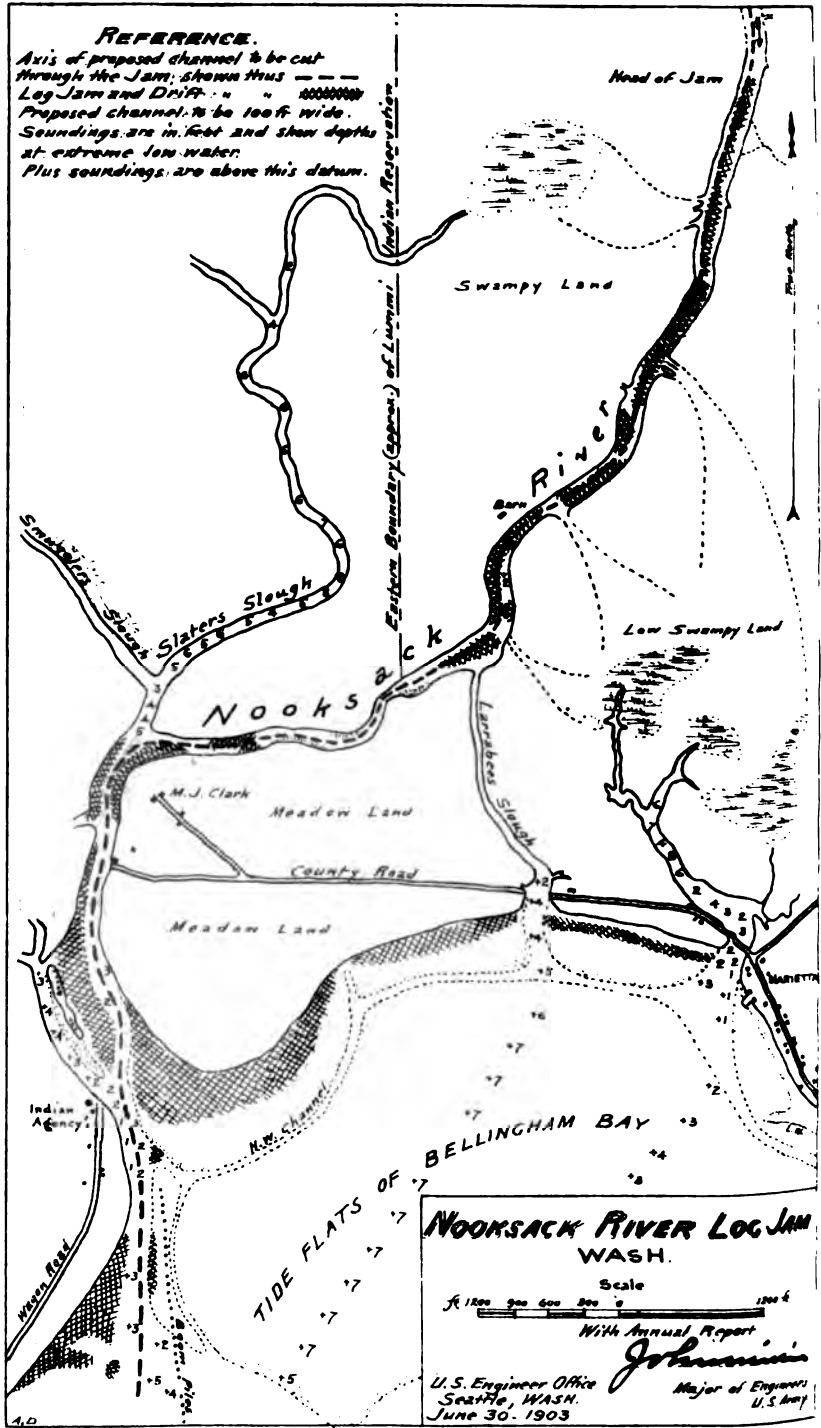








Axis of proposed channel to be cut  
through the Jam; shown thus — — —  
Log Jam and Drift: " " " 0000000000  
Proposed channel to be 100 ft. wide.  
Soundings are in feet and show depths  
at extreme low water.  
Plus soundings are above this datum.



*Number of snags and drift disposed of.*

Skagit River.....	1,328
Snohomish River.....	679
Stillaguamish River.....	60
Snoqualmie River.....	75
Skykomish River.....	33
Swinomish Slough.....	326
Hat Slough.....	28
North Fork of Skagit.....	204
<b>Total.....</b>	<b>2,728</b>

Total length, 53,224 feet. Largest diameter, 16 feet. Smallest diameter, 16 inches.

*Number of overhanging and other trees chopped.*

Skagit River.....	299
Snohomish River.....	75
Snoqualmie River.....	26
Skykomish River.....	14
<b>Total.....</b>	<b>414</b>

Total length, 84,942 feet. Largest diameter, 6 feet 4 inches. Smallest diameter, 8 inches.

Under the provisions of the act of June 13, 1902, authorizing the opening of the mouth of the Nooksak River, a detailed examination and survey were made and project submitted for the removal of the jam at the mouth of the river. This was approved May 6, 1903. Advertisements were issued on June 17, 1903, for bids to be opened July 17, 1903.

The work was in local charge of Capt. E. H. Jefferson, master snag boat *Skagit*, at the close of the year.

The opening of the Nooksak River, now provided for, and the large increase in the commerce on the streams and channels, particularly in that relating to the lumber business, call for an increased annual expenditure for maintaining navigation.

*Money statement.*

July 1, 1902, balance unexpended.....	\$41,166.94
June 30, 1903, amount expended during fiscal year.....	13,834.30
July 1, 1903, balance unexpended.....	27,332.64
July 1, 1903, outstanding liabilities.....	1,470.38
July 1, 1903, balance available.....	25,862.26
Amount that can be profitably expended in fiscal year ending June 30, 1905, in addition to the balance unexpended July 1, 1903.....	
Submitted in compliance with requirements of sundry civil act of June 4, 1897.....	
50,000.00	

## APPROPRIATIONS.

Act of—		Act of—	
June 14, 1880.....	\$2,500	August 18, 1894.....	\$14,000
August 2, 1882.....	20,000	June 3, 1896.....	75,000
July 5, 1884.....	10,000	March 3, 1899.....	20,000
August 5, 1886.....	10,000	June 13, 1902.....	35,000
August 11, 1888.....	15,000		
September 19, 1890.....	12,000	<b>Total.....</b>	<b>228,500</b>
July 13, 1893.....	15,000		

## COMMERCIAL STATISTICS.

*Skagit River and its tributaries.*

## EXPORTS AND IMPORTS.

Articles.	Exports.		Imports.	
	Quantity.	Value.	Quantity.	Value.
	<i>Tons.</i>		<i>Tons.</i>	
Agricultural implements.....			1,100	\$110,000
Flour.....			8,000	150,000
Grain.....	10,130	\$232,960		
Fish, fresh.....	287	17,220		
Hay.....	8,130	89,430		
Live stock.....	800	15,000	150	7,500
Miscellaneous merchandise.....	8,751	219,040	34,946	1,488,800
Total.....	22,508	573,680	39,196	1,751,800

Nine steam vessels, with an aggregate gross tonnage of 1,850 tons and maximum draft of 6 feet, were engaged in traffic on the Skagit River during the year. Number of passengers carried, 4,130.

Fourteen million two hundred and twenty-five thousand feet B. M., of saw logs; 21,276 cords of shingle bolts; and 801,836 linear feet of piling were towed and floated down the river during the year.

*Snohomish River and its tributaries.*

## EXPORTS AND IMPORTS.

Articles.	Exports.		Imports.	
	Quantity.	Value.	Quantity.	Value.
	<i>Tons.</i>		<i>Tons.</i>	
Lumber and products.....	4,805	\$92,550		
Piling.....	1,100	63,800		
Miscellaneous merchandise.....	557	29,000	2,400	\$13,750
Total.....	6,462	205,350	2,400	13,750

About 135,000,000 feet B. M., of saw logs were floated down the Snohomish River, and about 65,000,000 feet B. M., of logs were towed to the mills from other points.

One steamer of 19 tons and 18 inches draft made regular trips on the river, carrying 34,445 passengers. One small stern-wheel steamer made irregular trips to points on the river.

## Y Y 5.

## IMPROVEMENT OF HARBOR AT OLYMPIA, WASHINGTON.

A resurvey of the harbor was made and contract was entered into after usual advertisement for completing the dredging contemplated by the present project. The work will result in a channel 250 feet wide and 12 feet deep at mean lower low water, extending from deep water in the Sound to the city wharves. The contract requires completion of the channel by October 18, 1903. At the close of the year the contractors had not commenced dredging.

The full amount for this improvement, as heretofore authorized by Congress, has been appropriated.

The work was in local charge of Eugene Ricksecker, assistant engineer, at the close of the year.


# IMPROVEMENT OF OLYMPIA HARBOR, WASH.

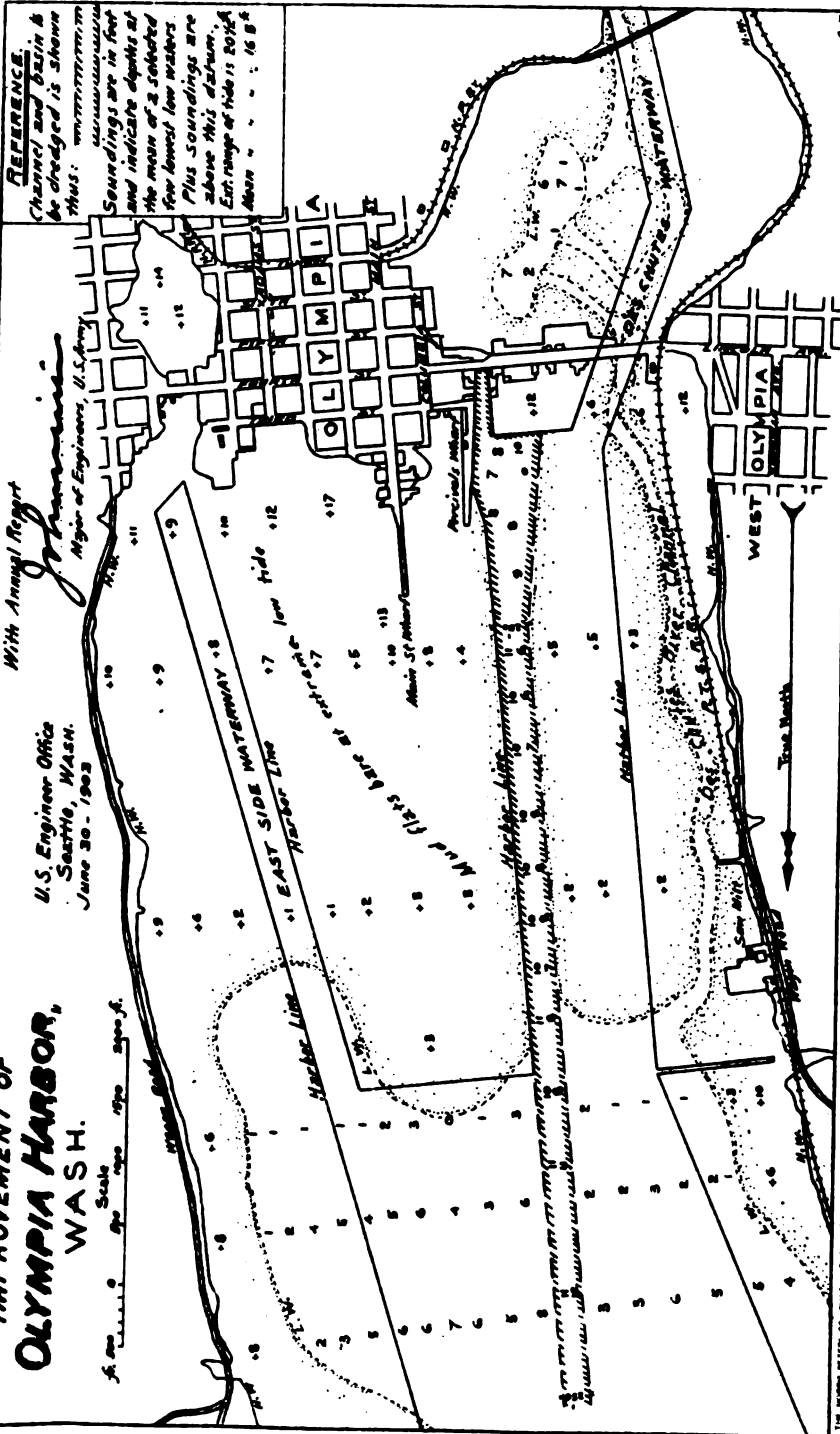
U.S. Engineer Office  
Seattle, WASH.  
June 30 - 1903

With Annual Report

*Johnnie*  
Major of Engineers, U.S. Army

Scale  
1" = 1000 ft.

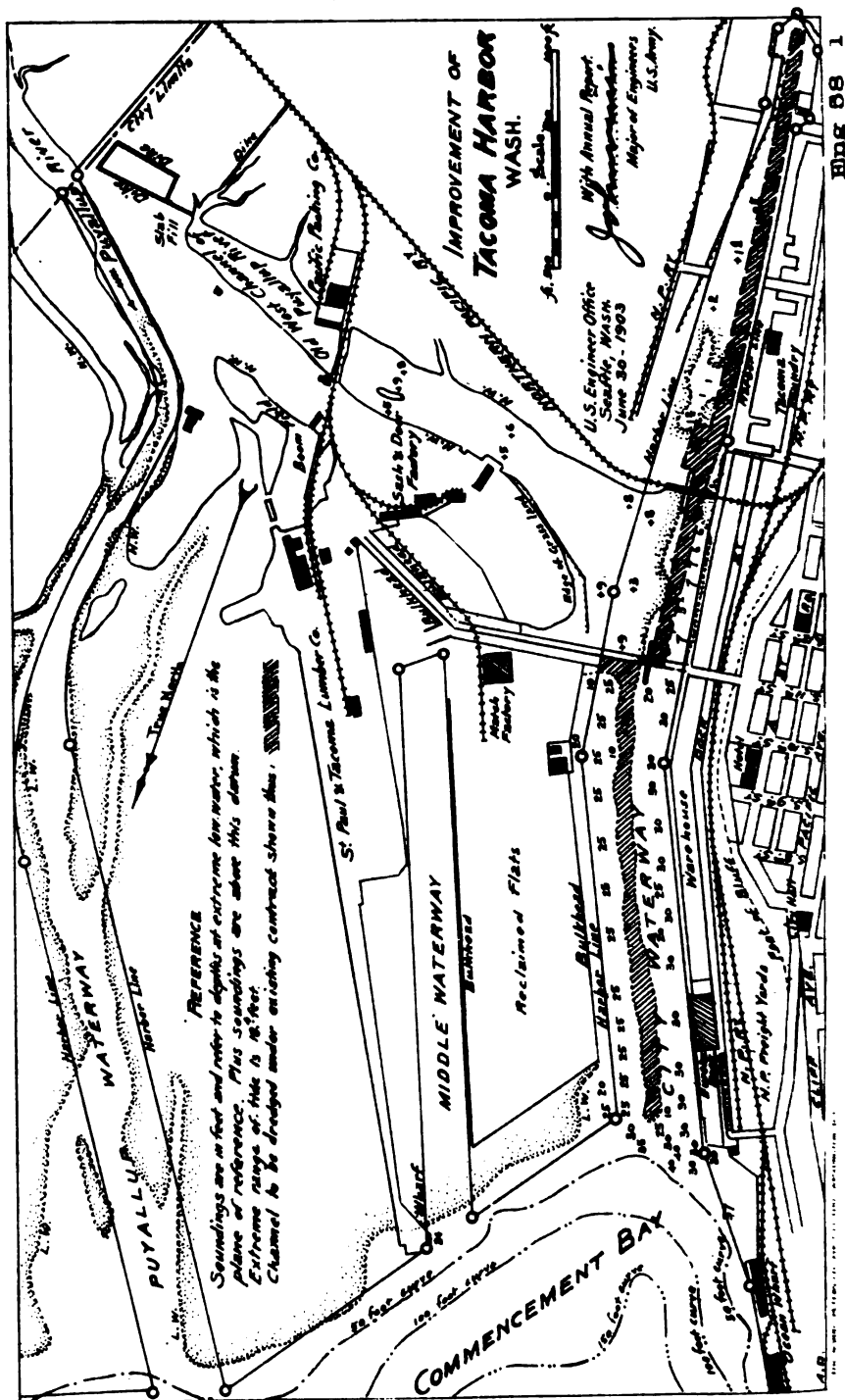
**REFERENCE.**  
Channel and Basin to be dredged is shown thus:   
Soundings are in feet and indicate depths at the mean of a selected low water. Plus soundings are above this datum. Estimate of tide is 20 ft. Mean - - - 16 ft.











*Money statement.*

July 1, 1902, balance unexpended.....	\$25,000.00
June 30, 1903, amount expended during fiscal year.....	1,264.76
July 1, 1903, balance unexpended.....	23,735.24
July 1, 1903, amount covered by uncompleted contracts.....	16,445.00
<hr/>	
{ Amount that can be profitably expended in fiscal year ending June 30, 1905, for maintenance of improvement, in addition to the balance unexpended July 1, 1903.....	
{ Submitted in compliance with requirements of sundry civil act of June 4, 1897, and of section 7 of the river and harbor act of 1899.	
	2,500.00

## APPROPRIATIONS.

Act of—		Act of—	
July 13, 1892.....	\$35,000	June 13, 1902.....	\$25,000
August 18, 1894.....	40,000		
June 3, 1896.....	32,000		147,000
March 3, 1899.....	15,000		

## CONTRACT IN FORCE DURING FISCAL YEAR.

Contractor: Puget Sound Bridge and Dredging Company.  
 Date of contract: January 27, 1903.  
 Date of approval: February 13, 1903.  
 Date of completion: October 18, 1903.

## COMMERCIAL STATISTICS.

The various persons and firms who were requested to furnish data necessary for the commercial statistics have not responded so as to permit completion of the statistics at the date of this report.

## Y Y 6.

## IMPROVEMENT OF TACOMA HARBOR, WASHINGTON.

Contract was entered into after due advertisement, for dredging the city waterway, with Raymond A. Perry, at 6.44 cents per cubic yard. The contract required dredging work to begin by June 4, and on that date dredging with a small plant was started. At the close of the year 7,400 cubic yards had been removed. A large hydraulic dredger is being constructed at Tacoma for this work. The hull has been completed and launched and installation of machinery is in progress.

The low price of the contract rate for dredging is partly due to the fact that the Northern Pacific Railway Company pays the contractor 3 cents per cubic yard for distributing the material on its tide lands.

The full amount for this improvement, as heretofore authorized by Congress, has been appropriated.

The work was in local charge of Eugene Ricksecker, assistant engineer, at the close of the year.

# 2332 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

## Money statement.

July 1, 1902, balance unexpended.....	\$75,000.00
Appropriated by act of March 3, 1903.....	100,000.00
	<hr/>
June 30, 1903, amount expended during fiscal year .....	175,000.00
	2,281.99
July 1, 1903, balance unexpended.....	<hr/>
July 1, 1903, outstanding liabilities.....	172,718.01
	410.98
July 1, 1903, balance available.....	<hr/>
	172,807.03
July 1, 1903, amount covered by uncompleted contracts .....	<hr/>
	185,240.00
<hr/>	
{ Amount that can be profitably expended in fiscal year ending June 30, 1905, for maintenance of improvement, in addition to the balance unexpended July 1, 1903 .....	
{ Submitted in compliance with requirements of sundry civil act of June 4, 1897, and of section 7 of the river and harbor act of 1899.	
	5,000.00

## APPROPRIATIONS.

Act of June 13, 1902.....	\$75,000
Act of March 3, 1903.....	100,000
	<hr/>
	175,000

## CONTRACT IN FORCE DURING FISCAL YEAR.

Contractor: Raymond A. Perry.  
Date of contract: February 24, 1903.  
Date of approval: March 30, 1903.  
Date of commencement: June 4, 1903.  
Date of completion: June 4, 1904.

## COMMERCIAL STATISTICS.

The various persons and firms who were requested to furnish data necessary for the commercial statistics have not responded so as to permit completion of the statistics at the date of this report.

Y Y 7.

## IMPROVEMENT OF WATERWAY CONNECTING PUGET SOUND WITH LAKES UNION AND WASHINGTON.

At the beginning of the year work was in progress on the first section of the preliminary canal cut in Salmon Bay. The cut is 16 feet deep at low water and 50 feet wide on the bottom. It has a length of 16,000 feet. The cut was advanced during the year 1,700 feet and was completed October 15, 1902. The total amount of excavation under the contract was 323,527 cubic yards. Amount removed during the





fiscal year, 128,473 cubic yards. On February 1, 1903, work begun on the second section of the cut, which under the act of June 13, 1902, was to be extended to the wharves at Ballard and was to be 10 feet deep at low water. It was made 50 feet wide at the bottom. This contemplates removal of about 280,000 cubic yards, and the length of the cut is about 4,200 feet, with a turning basin at the inner end. At the close of the year this cut had been advanced about 2,000 feet, covering much the heavier part of the work. The cut extending from the head of Salmon Bay to Lake Union was finished during the year. This cut is 10 feet wide on the bottom and has a depth reaching to within about 20 feet of the bottom proposed for the canal section. The last contract on this cut was finished February 3, 1903. The amount of material removed during the year was 32,217 cubic yards.

Observations of water levels and stream measurements were continued as long as required to furnish data needed by the special Board that was appointed under the act of June 13, 1902, to reconsider the canal project. A number of special surveys were made and maps prepared for the use of that Board.

The work was in local charge of J. M. Clapp, assistant engineer, at the close of the year.

Under the terms of the act of June 13, 1902, no definite project for this work has been adopted.

#### *Money statement.*

July 1, 1902, balance unexpended.....	\$244,227.68
June 30, 1903, amount expended during fiscal year.....	111,432.71
July 1, 1903, balance unexpended.....	132,794.97
July 1, 1903, outstanding liabilities.....	298.17
July 1, 1903, balance available.....	132,501.80
July 1, 1903, amount covered by uncompleted contracts.....	71,926.75

#### APPROPRIATIONS.

<b>Act of—</b>	
August 18, 1894.....	\$25,000
June 8, 1896.....	150,000
June 13, 1902.....	160,000
Total.....	335,000

#### CONTRACT IN FORCE DURING FISCAL YEAR.

Contractor: Puget Sound Bridge and Dredging Company.

Date of contract: January 27, 1903.

Date of approval: February 13, 1903.

Date of completion: December 18, 1903.

## 2334 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

## COMMERCIAL STATISTICS.

*Salmon Bay (Ballard).*

## SHIPPING.

	Arrived.		Departed.	
	Domestic.	Foreign.	Domestic.	Foreign.
Steam vessels .....	8	10	7	6
Sail vessels .....	23	18	26	15
Total .....	26	28	33	21

Aggregate gross tonnage: Tons.  
 Steam vessels ..... 26,000  
 Sail vessels ..... 38,000

One schooner of 1,060 tons and 6 launches and 10 fishing boats were constructed at the yards at Ballard.

Twenty-nine steam vessels, with an aggregate gross tonnage of 1,257 tons and maximum draft of 11 feet, were engaged in local traffic.

## EXPORTS AND IMPORTS.

Articles.	Exports.		Imports.	
	Quantity	Value.	Quantity	Value.
Machinery .....	Tons. 15	\$3,600	Tons. 7	\$414
Coal .....	52,000	315,000	4,500	9,225
Lumber and products .....	52,024	318,600	4,507	9,639
Total .....				

*Lakes Union and Washington.*

[Local traffic.]

Articles.	Quantity.	Value.
Coal .....	Tons. 14,422	\$25,462
Logs .....	75,000	187,500
Lumber and products .....	4,500	21,900
Piling .....	4,500	13,500
Telegraph poles .....	6,500	52,000
Wood .....	10,000	16,800
Miscellaneous merchandise .....	6,000	300,000
Total .....	121,542	604,162

Ten steam vessels, with an aggregate gross tonnage of 839 tons and maximum draft of 7 feet were engaged in traffic on the lakes. About 100,000 passengers were carried.

## Y Y 8.

## IMPROVEMENT OF EVERETT HARBOR, WASHINGTON.

Under authority of the joint resolution of Congress of April 23, 1902, the project for the work was modified by discontinuing the dredging in Old River and enlarging the harbor basin to a length of 5,500 feet and a width of 400 feet, with the depth originally planned of 26 feet at mean lower low water. The bulkheads were also to be raised and strengthened. Supplemental agreement to cover these changes was entered into with the contractors and approved on



February 3, 1903. Work under these modifications was begun as soon as they were authorized and continued to the close of the year, by which date it was nearly finished. Eight hundred and sixteen thousand six hundred and twenty-seven cubic yards of material was removed, and 3,772 linear feet of piling, 140,131 feet B. M. of lumber and 12,393 tons of stone were used in the bulkheads.

Appropriations have been made for this improvement to the limit of the expenditure heretofore authorized by Congress.

The work was in local charge of John Zug, junior engineer, at the close of the year.

*Money statement.*

July 1, 1902, balance unexpended.....	\$127,251.77
June 30, 1903, amount expended during fiscal year.....	89,745.35
July 1, 1903, balance unexpended.....	37,506.42
July 1, 1903, outstanding liabilities.....	253.00
July 1, 1903, balance available.....	37,253.42
July 1, 1903, amount covered by uncompleted contracts.....	27,027.27
Amount that can be profitably expended in fiscal year ending June 30, 1905, for maintenance of improvement, in addition to the balance unexpended July 1, 1903.....	
Submitted in compliance with requirements of sundry civil act of June 4, 1897, and of section 7 of the river and harbor act of 1899.	
	10,000.00

APPROPRIATIONS.

Act of—		Act of—	
August 18, 1895.....	\$10,000	March 3, 1901.....	\$90,000
June 3, 1896.....	20,000	June 28, 1902.....	117,000
March 3, 1899.....	50,000		
June 6, 1900.....	135,000	Total.....	422,000

CONTRACT IN FORCE DURING FISCAL YEAR.

Contractor: Seattle Bridge Company.  
 Date of contract: December 29, 1899.  
 Date of approval: January 16, 1900.  
 Date of commencement: July 22, 1900.  
 Date of completion: November 6, 1903.

COMMERCIAL STATISTICS.

*Shipping.*

	Arrivals.	Departures.
Steam vessels.....	12	12
Sail vessels.....	84	84
Total.....	46	46

Twelve ocean-going vessels, with an aggregate gross tonnage of 39,971 tons and maximum draft of 24 feet, and 15 sound and river boats, with an aggregate gross tonnage of 1,780 tons and maximum draft of 6 feet, were engaged in traffic.

*Exports and imports.*

	Exports.		Imports.	
	Quantity.	Value.	Quantity.	Value.
	<i>Tons.</i>		<i>Tons.</i>	
Ore .....			2,270	\$250,000
Lumber .....	84,400	\$187,739		
Paper .....	6,000	465,000		
Products of smelter .....	6,330	1,340,937		
Miscellaneous merchandise .....	13,647	629,990	22,616	1,170,845
Total .....	60,377	2,608,739	24,886	1,420,845

About 74,000,000 feet B. M. of saw logs were towed and floated to the mills at Everett. One sash and door factory and one stove factory were established during the year.

## Y Y 9.

## IMPROVEMENT OF SWINOMISH SLOUGH, WASHINGTON.

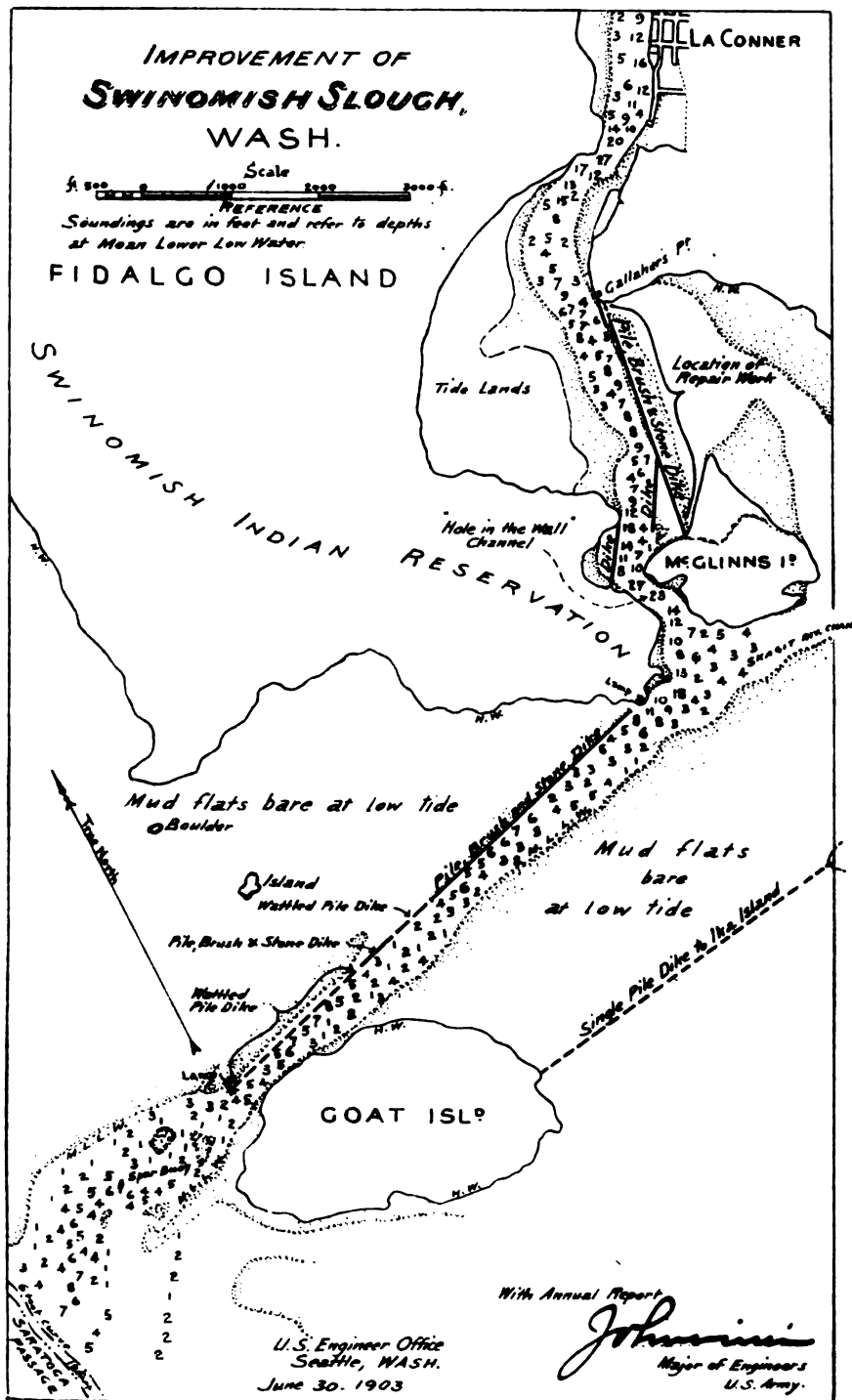
A small amount of repair work to the dikes and removal of drift and logs was done by hired labor and the snag boat *Skagit*. A break in the inner dike near Gallahers Point has existed for some years. This break is understood to have been first caused by a cut through the dike made by fishermen to get their boats through. A small length of supplemental dike inside the original one was built some years ago to close the break, but this also gave way or was cut. The flow of water through the opening with the rise and fall of tides scoured a deep hole, and the action of the storms driving in drift logs further injured the work and also threatened to break the levee or earthen dike protecting private property near. Shoaling of the channel in the vicinity resulted from this break, and it therefore became necessary to close this break before proceeding with other parts of the work. Repairs were started in September. Much difficulty was experienced in procuring material, and storms interfered with the work. When the break was finally closed the effect on the currents caused scour in other localities and a second break 300 feet west. This also had to be closed. After the repairing was finished a resurvey of the entire channel from La Conner to deep water in the sound was made preliminary to preparation of project for going on with the work. The map of this survey and preliminary estimates for the project were complete at the close of the year.

The work was in local charge of Thomas H. Huddleston, inspector, at the close of the year.

The full amount of the original estimate has been appropriated. A revision of the estimate will be necessary.

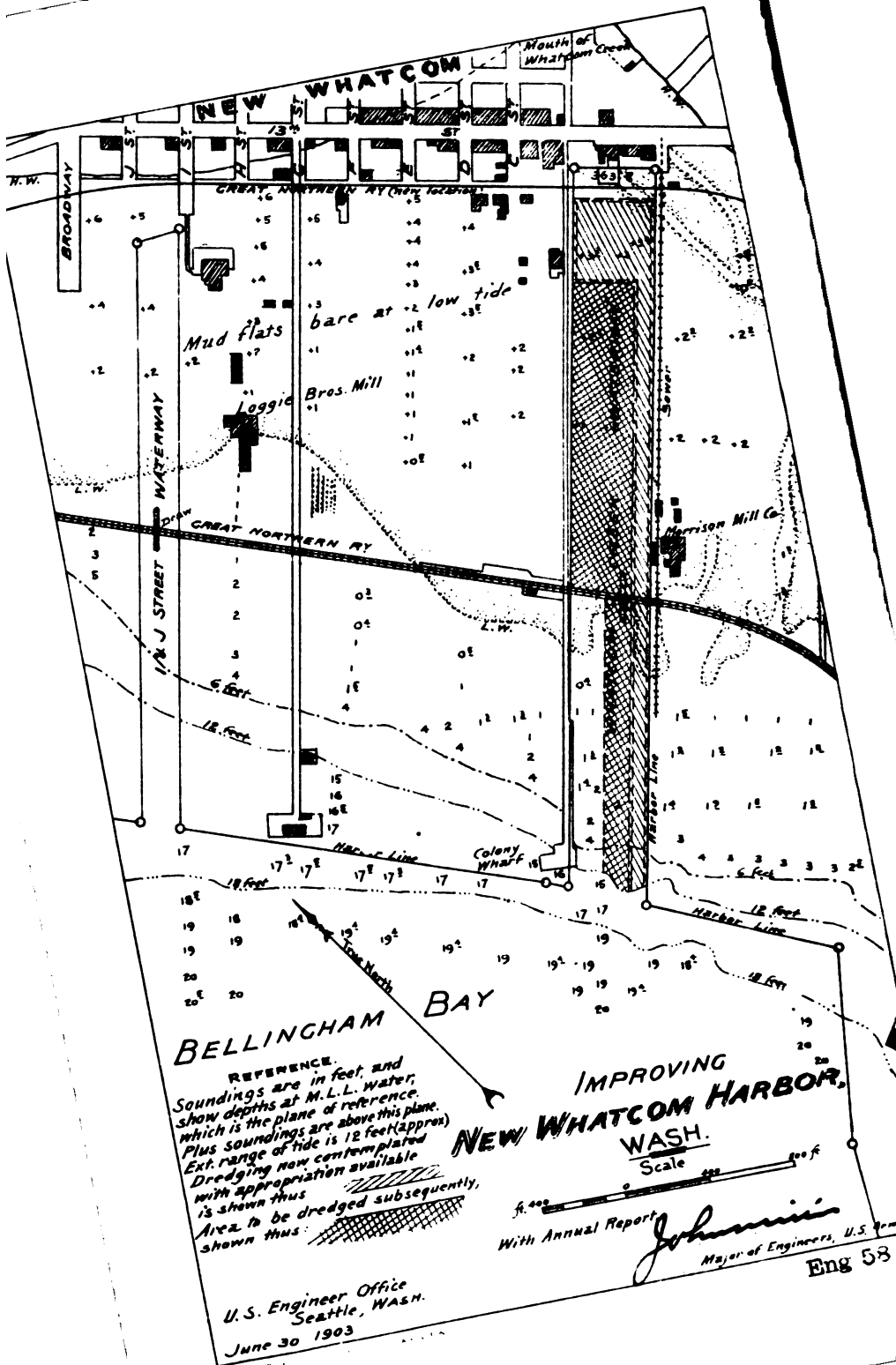
*Money statement.*

July 1, 1903, balance unexpended .....	\$34,551.41
June 30, 1903, amount expended during fiscal year .....	8,817.96
July 1, 1903, balance unexpended .....	26,233.45
July 1, 1903, outstanding liabilities .....	114.00
July 1, 1903, balance available .....	26,119.45
{ Amount (estimated) required for completion of existing project .....	17,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1905, in addition to the balance unexpended July 1, 1903:	
For works of improvement .....	\$17,000.00
For maintenance of improvement .....	5,000.00
	22,000.00
{ Submitted in compliance with requirements of sundry civil act of June 4, 1897, and of section 7 of the river and harbor act of 1899.	









## APPROPRIATIONS.

Act of—		Act of—	
July 13, 1892.....	\$25,000	June 13, 1902 .....	\$30,000
August 18, 1894.....	25,000		
June 3, 1896 .....	25,000	Total .....	125,000
March 8, 1899.....	20,000		

## COMMERCIAL STATISTICS.

*Exports and imports.*

Articles.	Exports.		Imports.	
	Quantity.	Value.	Quantity.	Value.
	<i>Tons.</i>		<i>Tons.</i>	
Agricultural implements.....	16	\$5,200	85	\$13,800
Fish, fresh .....	814	42,460		
Grain .....	25,000	625,000		
Hay .....	11,036	110,525		
Live stock.....	232	25,490	63	19,900
Lumber and products.....	200	1,200	1,160	11,081
Stone .....	1,352	1,235		
Wood .....			2,702	7,199
Miscellaneous merchandise .....	637	144,112	6,618	466,126
Total .....	39,237	955,272	10,627	517,575

Thirty-eight million feet B. M. of saw logs; 42,750 linear feet of piling, and 2,702 cords of wood were towed through the slough.

One steamer making regular trips and 10 steamers doing a jobbing business, with an aggregate gross tonnage of 1,609 tons and a maximum draft of 7 feet were engaged in local traffic.

## Y Y 10.

## IMPROVEMENT OF NEW WHATCOM HARBOR, WASHINGTON.

The act of June 13, 1902, making the first appropriation for this work provided that no money should be spent until satisfactory arrangements had been made to prevent sawmill refuse from going into the waterway to be dredged. Long delay in taking action to begin work resulted from this cause, but on June 9, 1903, upon report and recommendation from this office, the Secretary of War authorized taking action to begin work.

Bids for the dredging under approved specifications were then invited by advertisement of June 22, 1903, bids to be opened July 22, 1903.

This work was in local charge of H. S. Shorey, inspector, at the close of the year.

*Money statement.*

July 1, 1902, balance unexpended .....	\$25,000.00
July 1, 1903, balance unexpended .....	25,000.00
July 1, 1903, outstanding liabilities .....	138.50
July 1, 1903, balance available .....	24,861.50
{ Amount (estimated) required for completion of existing project....	55,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1905, in addition to the balance unexpended July 1, 1903 .....	55,000.00
{ Submitted in compliance with requirements of sundry civil act of June 4, 1897.	

## 2338 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

## APPROPRIATION.

Act of June 13, 1902 ..... \$25,000

## COMMERCIAL STATISTICS.

*Shipping.*

	Arrived.	Ton- nage.	Departed.	Ton- nage.
Steam vessels .....	5	10,605	5	10,605
Sail vessels .....	17	10,880	17	10,880
Total .....	22	21,485	22	21,485

Maximum draft of vessels, 24 feet 6 inches.

Five steamers with an aggregate gross tonnage of 2,407 tons and maximum draft of 10 feet 6 inches, were regularly engaged in local traffic between Bellingham Bay and other Puget Sound ports.

*Exports and imports.*

	Exports.		Imports.	
	Quantity.	Value.	Quantity.	Value.
	<i>Tons.</i>		<i>Tons.</i>	
Cement .....	687	\$10,005	2,375	\$35,625
Feed and grain .....			4,376	133,280
Hay .....			497	5,364
Lumber and products .....	57,775	450,025		
Salmon, fresh .....	55	6,600	174	10,770
Stone .....			1,800	5,600
Miscellaneous merchandise .....	3,857	464,550	15,042	1,750,970
Total .....	62,354	\$31,180	24,764	1,941,609

## Y Y II.

IMPROVEMENT OF THE OKANOGAN AND PEND OREILLE RIVERS,  
WASHINGTON.

Work on the Okanogan was prosecuted during the low-water season from September 10, 1902, to December 21, 1902, when operations were terminated by ice. The work consisted in removing bowlders, constructing and restoring wing dams, and dredging shoal bars with a toothed steel drag or scraper, operated from a barge by a portable engine. Eleven miles of river were covered by this work, including six rapids. The low-water channel was deepened to about 24 inches. The original shoal places had from 8 to 11 inches of water. The channel was also straightened and made not less than 70 feet wide. About 730 tons of bowlders were removed from the channel, 522 linear feet of wing dam were built, and 266 linear feet of riprap was placed. When work stopped the plant was secured for the winter and is ready to resume work as soon as the stage of water permits.

The amount available for the Pend Oreille was so small that the purchase of a plant did not seem warranted. The river was examined from Newport down. The construction work was deferred till that on the Okanogan might be further advanced so a part of the tools and plant for that river would be available on the Pend Oreille. Subsequently instructions were received to proceed with the Pend Oreille work without waiting for completion of that on the Okanogan, and action has been taken to prepare a plant which will be ready for



work as soon as the stage of the river permits operations on the shoals and obstructions below Usk.

The work was in local charge of C. E. Hansen, overseer, at the close of the year.

*Money statement.*

July 1, 1902, balance unexpended.....	\$23,715.50
June 30, 1903, amount expended during fiscal year.....	7,425.00
July 1, 1903, balance unexpended.....	16,290.50
July 1, 1903, outstanding liabilities.....	72.45
July 1, 1903, balance available.....	16,218.05
(Amount (estimated) required for completion of existing project.....	12,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1905, in addition to the balance unexpended July 1, 1903.....	12,500.00
Submitted in compliance with requirements of sundry civil act of June 4, 1897.	

APPROPRIATIONS.

Act of March 3, 1899.....	\$25,000
Act of June 18, 1902.....	22,500
Total.....	47,500

COMMERCIAL STATISTICS.

*Okanogan River.*

EXPORTS AND IMPORTS.

Articles.	Exports.		Imports.	
	Quantity.	Value.	Quantity.	Value.
	<i>Tons.</i>		<i>Tons.</i>	
Agricultural implements.....	10	\$1,000	100	\$8,000
Hides.....	20	500	50	5,000
Machinery.....	100	40,000	101	1,800
Ore.....			1,190	62,705
Lumber and products.....	130	41,500	1,441	77,565
Wool.....				
Miscellaneous merchandise.....				
Total.....				

Three steamers, with an aggregate gross tonnage of 856 tons and maximum draft of 4 feet 6 inches, made 55 trips on the Okanogan River to Riverside, about 43 miles above its mouth, during May and June, 1902.

*Pend Oreille River.*

EXPORTS AND IMPORTS.

Articles.	Exports.		Imports.	
	Quantity.	Value.	Quantity.	Value.
	<i>Tons.</i>		<i>Tons.</i>	
Agricultural implements.....	20		80	\$800
Flour and grain.....	1,100		1,100	19,400
Hay.....	500	\$5,000		
Live stock.....	1,500	60,000		
Lumber and products.....	10,850	63,200		
Miscellaneous merchandise.....	568	27,500	1,330	324,300
Total.....	13,418	155,700	2,450	344,500

Four steamers, with an aggregate gross tonnage of 120 tons and maximum draft of 4½ feet, were engaged in traffic on the Pend Oreille River. One steamer made weekly trips from Newport to the head of Box Canyon, a distance of about 54 miles. The other made daily trips between Newport and Usk, a distance of about 18 miles. All heavy freight was transported on barges towed by the steamers.

Y Y 12.

REPORT OF A BOARD OF ENGINEERS UPON THE FEASIBILITY AND ADVISABILITY OF CONSTRUCTING A CANAL, WITH NECESSARY LOCKS AND DAMS, CONNECTING PUGET SOUND WITH LAKES UNION AND WASHINGTON, OF SUFFICIENT WIDTH AND DEPTH TO ACCOMMODATE THE LARGEST COMMERCIAL AND NAVAL VESSELS, WITH PLANS AND ESTIMATES OF COST THEREOF.

[Printed in Senate Document No. 127, Fifty-seventh Congress, second session.]

OFFICE CHIEF OF ENGINEERS,  
UNITED STATES ARMY,  
*Washington, January 27, 1903.*

SIR: The river and harbor act approved June 13, 1902, in the item making appropriation for improving waterway connecting Puget Sound with Lakes Union and Washington, Washington, provided for the appointment by the Secretary of War of a Board of Engineers to make such surveys, examinations, and investigations as may be required to determine the feasibility and advisability of constructing a canal, with necessary locks and dams, of sufficient width and depth to accommodate the largest commercial and naval vessels, etc.

The Board was duly appointed, and I have now the honor to submit the accompanying copy of its report, dated January 6, 1903, with maps,<sup>a</sup> which I recommend be transmitted to Congress, as required by the law.

Very respectfully, your obedient servant,

G. L. GILLESPIE,  
*Brig. Gen. Chief of Engineers,*  
*U. S. Army.*

Hon. ELIHU ROOT,  
*Secretary of War.*

REPORT OF BOARD OF ENGINEERS.

SAN FRANCISCO, CAL., *January 6, 1903.*

GENERAL: The Board appointed by paragraph 7 of Special Orders, No. 19, Headquarters Corps of Engineers, U. S. Army, Washington, July 5, 1902, has the honor to submit the following report:

The order appointing the Board reads as follows:

SPECIAL ORDERS, } No. 19.	HEADQUARTERS CORPS OF ENGINEERS, U. S. ARMY, <i>Washington, July 5, 1902.</i>
------------------------------	--

[Extract.]

\* \* \* \* \*

7. By authority of the Secretary of War, and in accordance with the provisions of the river and harbor act of June 13, 1902, a board of officers of the Corps of Engineers, to consist of Lieut. Col. William H. Heuer, Capt. William C. Langfitt, First Lieut. Robert P. Johnston, will assemble at Seattle, Wash., upon the call of the senior member, to make surveys, examinations, and investigations as may be required to determine the feasibility and advisability of constructing a canal, with necessary locks and dams, connecting Puget Sound with Lakes Union and Washington, of sufficient width and depth to accommodate the largest commercial and

<sup>a</sup> Not reprinted; printed in Senate Document No. 127, Fifty-seventh Congress, second session.

naval vessels, and to prepare and report plans and estimates of the cost thereof. The Board will also examine the route for a similar canal connecting Elliott Bay with Lakes Washington and Union, with a view to determine the feasibility of such route, and shall invite proposals from the Seattle and Lake Washington Waterway Company for the construction of a similar canal over said route connecting Elliott Bay with Lake Washington, and similar proposals for connecting Elliott Bay with Lake Union through Lake Washington, said proposals to specify the time for the completion of each project, and all rights and privileges to be reserved by said company. The Board will also report upon the relative advantages of all proposed routes.

The Board is authorized to visit such points as it deems necessary for the proper performance of its duties.

Upon the completion of the duty assigned them, the members of the Board will return to their proper stations.

The journeys required under this order are necessary for the public service.

\* \* \* \* \*

By command of Brig. Gen. Gillespie:

CHAS. S. BROMWELL,  
*Captain, Corps of Engineers.*

In compliance with this order, the Board met at Seattle on the morning of August 4, 1902, and again had long sessions on the 5th, 6th and 7th. The proposed canal route via Shilshole Bay and Lake Union, and a portion of the route which the Seattle and Lake Washington Waterway Company proposes to follow in constructing a canal from Elliott Bay to Lake Washington, were gone over and carefully examined; and the Smith's Cove, Mercer Farm, and Tramway routes were viewed; the various bodies of water concerned, including the Seattle water front, were examined; much written and printed matter pertaining to the subject was read, and a public meeting was held on August 7, at which, as had been previously announced, all parties interested were invited to submit in writing their views on the questions under consideration. The documents thus presented were read aloud at this meeting and are forwarded herewith as appendixes to this report.

The Board reassembled in Seattle on the morning of November 17, 1902, and remained in session for three days. After due notice, published in the local papers, another public meeting was held in the rooms of the Seattle Chamber of Commerce on the afternoon of November 19, 1902. Persons wishing to state their views in regard to the proposed canal were invited to do so at this meeting, but no one responded to this invitation and the meeting was therefore adjourned.

In addition to the investigations made by the Board as a body, much time has been devoted by its members individually to the study of the various questions involved.

Since the Board is directed to consider a canal "of sufficient width and depth to accommodate the largest commercial and naval vessels," the dimensions necessary to comply with this requirement had to be decided upon as one of the first preliminaries to further investigation.

In a letter of January 10, 1902 (printed in House Doc. No. 335, Fifty-seventh Congress, first session), Maj. John Millis, Corps of Engineers, the district engineer officer, submitted an estimate of the cost of a canal of sufficient size to "accommodate the largest ships of the Navy and the largest commercial vessels now afloat or in contemplation that are likely to come to this port," and after mature consideration the Board decided that the dimensions contemplated therein meet the prescribed requirements. Hence these dimensions were adopted, and in inviting proposals from the Seattle and Lake Wash-

ington Waterway Company the Board specified that the proposals should be based upon a canal affording similar accommodations. The general arrangement and the principal dimensions contemplated in Major Millis's project are given in the following paragraphs, quoted from his report:

7. The depth in salt water, or from the western entrance to the basin below the lock, is 25 feet at extreme low water, affording a depth of 34 feet at lowest high water. The depth of the basin below the lock is 34 feet at extreme low water, which will enable a vessel of the greatest draft to lie at all stages of the tide. The depth from above the lower lock through to the upper lock is to be 35 feet below normal stage of Lake Union, at which level this portion of the waterway is to be maintained. The depth from above the upper lock to deep water in Lake Washington is to be 35 feet below average low water in Lake Washington. This level is about one-half foot higher than the lowest stage heretofore observed in Lake Washington, but this stage was reached with the small portage canal open.

8. Both locks to be single, 86 feet by 720 feet in clear dimensions of lock chamber, with 35 feet of water over the sills; both to have guard gates above and below and intermediate gates to make available one lock chamber 400 feet long and one about 270 feet long. The lift of the lower lock will vary with the tide from 7 feet to 25 feet. The lift of the upper lock will be from 7 feet to 13 feet, depending on the stage at Lake Washington. The lower lock will be built largely in a cutting on the north side of the channel. There will be a dam, with spillway, abreast of this lock, and a basin above as well as below, each about 300 feet wide and 900 feet long. The upper lock will be entirely in excavation at the "portage." No special works for regulating the level of Lake Washington are now contemplated at this point.

The bottom width contemplated varies from 120 to 300 feet, and the side slopes under water from 1 on  $1\frac{1}{2}$  to 1 on 3, while side slopes above water are 1 on 1.

The minimum radius of curvature is 1,719 feet. This is probably shorter than the minimum radius on any other existing or contemplated large ship canal, but, owing to the conformation of the ground and bodies of water traversed by the proposed canal, it is difficult to enlarge the radius.

In the route upon which estimates are made by the Board none of these curves are very long (except in Lake Union, where there is an abundance of deep water), and the width of canal at curves is so increased that it is thought large vessels would have no difficulty in keeping the channel.

#### SURVEYS.

The Board found that all necessary information had been obtained to enable estimates to be made over what is known as the Shilshole Bay route, except over a small portion where a change in the alignment seemed desirable. The local officer, on request from the Board, obtained the necessary information for completing the estimates for this new portion of the route.

The information as to the nature of material to be encountered on the route proposed by the Seattle and Lake Washington Waterway Company was not thought sufficient to enable a careful estimate of the cost of excavation along this route to be made; but as sufficient data could be obtained only by making a complete set of deep and expensive borings, the Board, for reasons that appear later, did not consider it advisable to recommend this expenditure.

As will be seen, the Board soon eliminated from consideration all routes except these two, and hence concluded that no further surveys would be necessary.

## HISTORY AND DESCRIPTION.

The question of a canal to connect Puget Sound with Lakes Union and Washington has been previously considered and reported upon by various officers and boards of officers of both the Army and the Navy, to whose reports reference is hereby made.

## SEATTLE.

Seattle, the largest city in Washington, said to contain a population exceeding 110,000 persons, is situated on Elliott Bay, an indentation of the eastern shore of Puget Sound, and about midway between its upper and lower ends. Lake Union is about 1 mile northeast and Lake Washington about  $2\frac{1}{4}$  miles east of the water front of the city. Elliott Bay is separated from Lake Union by a ridge or hill whose crest height rises from 150 to upward of 300 feet above tide water, and from Lake Washington by ridges or hills whose crest heights rise from 200 to upward of 300 feet above tide water in Puget Sound. From a pamphlet issued by the Seattle Chamber of Commerce the following has been extracted:

It (i. e., Seattle) has a magnificent harbor, perfectly protected from storms and accessible to the largest vessels afloat at all times and at all stages of the tide. The storage capacity of the wharves, warehouses, and elevators on the water front is 712,900 tons, and the berths for vessels alongside of the wharves are sufficient to accommodate a line of ships 4 miles long. Two-thirds of these improvements have been erected since June 1, 1900. The assessed valuation of property in Seattle is \$42,980,924. On January 1, 1902, the city had 115.69 miles of improved streets. The street-railway system aggregates 120 miles in length. The Puget Sound Navy-Yard is just across the Sound. On June 1, 1900, Seattle had 958 manufacturing establishments, and the products of the preceding year were valued at \$26,373,497. The climate is mild and equable; the temperature seldom exceeds 85°; the average annual rainfall in the past ten years has been 36.46 inches, with very little snow.

The following description and data concerning Salmon Bay and Lakes Union and Washington and the various possible routes for the canal under consideration are taken from the report submitted on December 15, 1891, by a Board consisting of Col. G. H. Mendell (now deceased), Maj. (now Lieut. Col.) Thos. H. Handbury, and Capt. (now Maj.) Thos. W. Symons, all of the Corps of Engineers, U. S. Army. The report of said Board was printed in House Document No. 40, Fifty-second Congress, first session, and also in the Annual Report of the Chief of Engineers, U. S. Army, for 1892, page 2762 et seq.

## LAKE UNION.

Lake Union, which is nearest to the heart of Seattle and to the Sound, is the smallest of these lakes. It has an area of 905 acres, of which 499 acres cover a depth of 25 feet, and with a maximum observed depth of 60 feet. The area of the drainage basin of this lake is 6 square miles.

This lake receives, in addition to the supply of water from its drainage basin, a considerable supply from Lake Washington, through a canal which has been cut through the divide separating the two lakes, and which is used for the passage of saw logs and small vessels.

The outlet of Lake Union is a small stream running from its extreme western end into Salmon Bay. The distance between the lake and the bay is 5,700 feet.

The general and average elevation of the surface of the water in Lake Union is 25.5 feet above extreme low water in Puget Sound, or 7.8 feet above extreme high water.

## LAKE WASHINGTON.

Lake Washington, the largest of the three lakes, lies directly east of Lake Union and of Seattle. It is 19 miles long, averages about 2 miles in width, and has an

# 2344 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

area of 38.9 square miles, or 24,896 acres, of which probably 22,000 acres cover a depth of 25 feet or more.

The depth of this lake is very great. Soundings were not made over the entire area of the lake; but it is stated on apparently creditable authority that depths of 600 feet have been observed.

The deepest water observed was 150 feet, the length of the sounding line used.

The area of the drainage basin of the lake is 183 square miles. It receives, in addition, the drainage of the basin of Samamish Lake and River, the areas of which amount to 211 square miles.

The outlet of the lake is Black River, which unites with White River 2.5 miles below the lake, forming the Duwamish River. The Duwamish River follows a tortuous course for about 14 miles and empties into Duwamish Bay. A short distance below the outlet of the lake the Cedar River joins the Black River and flows with it to the Duwamish, except in times of flood in Cedar River, when the waters of Cedar River run partly into Lake Washington, which thus acts as a safety valve to prevent excessive flooding of the Duwamish River valley.

The general elevation of the surface of the lake is 33 feet above extreme low water in Puget Sound, or 15.3 feet above the highest tides. It is 7.5 feet above that of Lake Union.

The most extensive shoals of Lake Washington, where the water has a depth of less than 25 feet, are at the head and at the foot of the lake and in Union Bay. That at the head of the lake, formed by the deposition of sediment brought down by the Samamish River, covers an area of about 300 acres. That at the foot of the lake is evidently formed by the deposition of sediment brought down Cedar River during floods, when a large volume of the waters of that river is emptied into the lake. The area of this shoal is about 300 acres.

The shoal in Union Bay covers an area of 610 acres, almost the entire area of that bay.

The localities of the remaining shoals and their areas are as follows:

	Acres.
Juanita Bay, north of Kirkland, about .....	150
Three indentations, south of Houghton, about .....	200
Meydenbauer Bay, about .....	75
Mercer Slough Bay, about .....	200
Island shoal, about .....	25
Waterworks Bay, about .....	25

\* \* \* \* \*

## SALMON BAY.

Salmon Bay is an estuary connecting through Shilshole Bay with Puget Sound. In these bays the tide has a mean range of about 11 feet and an extreme range of nearly 18 feet.

At extreme high tide the level of Salmon Bay is 7.8 feet below the usual level of Lake Union.

This bay has not sufficient depth, even at high stage of tide, for the passage of vessels of considerable draft.

It will be seen hereafter that the recommended projects provide that the level of the water of Salmon Bay be raised to and maintained at the level of Lake Union, 7.8 feet above extreme high tide.

This will necessarily cause the shores of Salmon Bay to be permanently submerged. Part of the submerged land, particularly in the town of Ballard, is occupied by buildings and wharves.

While the raising of the level of Salmon Bay must, to a very large degree, increase values of riparian lands by making a deep-water harbor, yet the submergence of certain lands gives rise to damages and loss, the particular dimensions of which have not been ascertained by the Board. These constitute a liability which is not embraced in the estimates.

The proper disposition of material excavated from the canal prism, and from the bays and lakes, by dredging in raising these submerged lands will be a factor in reducing considerably the measure of these damages.

\* \* \* \* \*

## ROUTES.

There are five possible routes for a canal connecting Lakes Union and Washington with Puget Sound.

First. By way of Duwamish Bay and the valley of the Duwamish and Black rivers to Lake Washington, and across the Portage from Lake Washington to Lake Union.

Second and third. By way of depressions between the southern part of Lake Union and Duwamish Bay. (These routes were considered twenty years ago by Gen. Barton S. Alexander, and are known in his report as the "Mercer farm route" and the "Tramway route.") Thence from Lake Union to Lake Washington by a canal through the Portage.

Fourth. By way of Shilshole Bay, Salmon Bay, the valley of the outlet of Lake Union to Lake Union, and thence between Lakes Union and Washington by a canal through the Portage.

Fifth. By way of Smiths Cove to the upper end of Salmon Bay; thence as in the preceding route.

The first route, by the valley of the Duwamish, was soon eliminated from serious consideration by its great cost and other disadvantages.

The second and third routes were practicable twenty years ago, when Seattle was a straggling village, but the land traversed by these routes is now built up with business blocks and residences, and the cost of the right of way is prohibitory.

The fourth and fifth routes are entirely feasible. They have received full consideration, and estimates of cost by both routes are submitted.

These two routes coincide in alignment from Lake Washington to Salmon Bay; they differ in that one makes the connection with Puget Sound from the head of Salmon Bay by the lower end of Salmon Bay and Shilshole Bay, and the other through a low gap to Smiths Cove and Duwamish Bay.

In each of the projects, by Shilshole Bay or by Smiths Cove, vessels are to pass from the waters of Puget Sound to Salmon Bay through a masonry lock placed close to the sound, having a lift varying according to the stage of the tide.

The dimensions of the lock are as follows: Length, 400 feet; net width, 50 feet; depth on the sill at extreme low stage of tide, 16.6 feet.

\* \* \* \* \*

The Shilshole Bay system costs \$600,000 less than that by Smiths Cove. On the other hand, the latter route possesses advantages in that its entrance is in the harbor of Seattle, whereas the entrance to the other is  $5\frac{1}{2}$  miles distant; and, secondly, the Smiths Cove entrance and lock are less exposed to bombardment by an enemy's fleet. For these reasons the Smiths Cove route is to be preferred.

By either of these routes there will be added to the commercial facilities of Seattle three fresh-water areas, where timber wharves can be constructed and cheaply maintained, and where vessels can lie in perfectly quiet water of a constant level.

In the sound at Seattle the tide has an average range of more than 11 feet, and an extreme range of nearly 18 feet. These oscillations of level are all embarrassing to commerce, and wooden wharves are liable to be destroyed by the teredo in a few months. Marine insects are very destructive to piling and other timber placed in the waters of Puget Sound.

Salmon Bay, maintained at the level of Lake Union, will contain 35 acres of water area more than 25 feet deep, and an additional area of 165 acres can be brought to the same depth by a moderate amount of dredging.

Lake Union has an area of 499 acres of a depth of 25 feet, which can, if desirable, be increased by dredging. The total area of the lake is 905 acres.

These two areas combined about equal the total area of the docks of London, and they can readily be made equal by dredging to the area of the Liverpool docks.

Lake Washington area contains 38.9 square miles, or about 25,000 acres, of which about 22,000 acres are covered with a greater depth of water than 25 feet.

\* \* \* \* \*

It will be noted that the route over which the Seattle and Lake Washington Waterway Company proposes to construct a canal connecting Puget Sound with Lake Washington was not considered by the above-named Board, as the above company was not then in existence, and probably no proposal for a canal over this route had ever been made.

The route, although short and direct, did not, and does not, possess the natural advantages generally sought in locating important works of this character. The advantages possessed by this route depend upon extraneous conditions and not upon features naturally pertaining to canal construction.

It will also be noted that, for reasons stated, the above-named Board eliminated all the routes except those by way of Shilshole Bay and Smiths Cove. These two routes coincide throughout most of their length, differing only between Puget Sound and the upper end of Salmon Bay. Of these two, the Smiths Cove route was preferred by the aforesaid Board, but the Shilshole Bay route was subsequently adopted. In order to set forth the relative advantages of the two routes, the following brief history of the selection of the Shilshole Bay route will be given:

The river and harbor act of August 18, 1894, contained the following provision:

For dredging Salmon Bay, and the improvement of the waterway connecting the waters of Puget Sound, at Salmon Bay, with Lakes Union and Washington by enlarging the said waterway into a ship canal, with the necessary locks and appliances in connection therewith, \$25,000: *Provided*, That no part of said amount shall be expended on the improvement of the waterway connecting the waters of Puget Sound with Lakes Union and Washington until the entire right of way and a release from all liability to adjacent property owners have been secured to the United States free of cost and to the satisfaction of the Secretary of War.

The sundry civil bill of March 2, 1895, provided for the expenditure of \$5,000 of the above sum—

in making a definite survey and location of said improvement and in preparing a cadastral map showing each piece of property required to be deeded to the United States or from which a release is required, with its metes and bounds.

Since both of the above acts referred to "the waterway connecting the waters of Puget Sound at Salmon Bay with Lakes Union and Washington," and since the only existing waterway was by way of Shilshole Bay, it was assumed by the district engineer officer that this was the route selected by Congress, and hence this route alone was embraced by the survey made pursuant to the latter act.

The river and harbor bill of June 3, 1896, appropriating \$150,000 for the improvement of this waterway and for enlarging it into a ship canal, provided, however, that said canal should be "constructed either by the Smiths Cove route or Shilshole Bay route, in the discretion of the Secretary of War," and on September 22, 1896, the Secretary of War designated the Smiths Cove route.

But in March, 1898, a Board, consisting of Capt. (now Maj.) W. L. Fisk, Capt. Harry Taylor, and First Lieut. (now Capt.) Chas. L. Potter, all of the Corps of Engineers, was appointed—

for the purpose of considering and reporting on the subject of the most feasible route for the waterway connecting the waters of Puget Sound with Lakes Union and Washington, with special reference to the terminal point at the Sound end of the said waterway.

This Board recommended the Shilshole Bay route as being—

First. Less exposed to heavy winds.

Second. More easily defended.

Third. More free from objectionable curves.

Fourth. Free from certain complications attaching to the Smiths Cove route on account of a contract between the State of Washington and certain parties for filling in a portion of the tide lands, etc.

Fifth. Probably free from quicksand, which it was thought would be encountered on the Smiths Cove route.

Sixth. Cheaper.

Seventh. But slightly less convenient to vessels passing between the Seattle water front and the lakes, and more convenient for vessels going from the lakes direct to sea or vice versa.



Eighth. Free from certain objections pertaining to the Smiths Cove route on account of its being partly occupied by the Great Northern Railroad.

This Board also suggested "that the outer lock be drawn back from the Sound end of the canal to a point near the upper end of the narrowest part of Salmon Bay."

These recommendations were approved by the Secretary of War on April 14, 1898, since which date all work has been confined to the Shilshole Bay route.

The present Board concurs with the Board of 1891 in believing either the Shilshole Bay route or the Smiths Cove route preferable to any of the other routes then considered, and with the Board of 1898 in considering the Shilshole Bay route preferable to that by way of Smiths Cove. Besides the arguments in favor of the Shilshole Bay route set forth by the Board of 1898, and briefly enumerated above there now exists the very substantial additional argument, that, in compliance with the provisions of the above-named acts of August 18, 1894, and June 3, 1896, the right of way and release from liability by way of Shilshole Bay have already been secured by the county of King, at a cost said to be about \$250,000, and donated to the United States free of charge.

#### FEASIBILITY.

Having decided upon the Shilshole Bay route as being the most advantageous of the routes via Lake Union, and having gone over this route and examined the maps thereof and the character of the material to be excavated as revealed by the work already done and by the borings made, the Board decided that there is no doubt of the entire feasibility of constructing on this route a canal of the required dimensions.

#### ADVISABILITY.

The advisability of constructing the canal depends, on the one hand, upon its cost, cost of operation, maintenance, etc., and on the other hand, upon the resulting benefits.

In this particular case there is also a third consideration which should be alluded to, but the weight of which it is not within the province of this Board to determine. This is the moral or legal obligation which the people of Seattle and Washington allege was assumed by the General Government when, by the provisions of the act of August 18, 1894, quoted in paragraph 18, it called for and subsequently accepted the right of way and release from liability free of cost to the United States. As stated in paragraph 24, this right of way and release are said to have cost the county of King about \$250,000.

There is little doubt that the people interested in the proposed canal took this provision as an agreement to the effect that if they would provide the right of way the Government would build the canal. They now argue that, since they have fulfilled their part of the said agreement, it is incumbent upon the Government to fulfill its part.

This matter is referred to by Mr. Erastus Brainerd in a paper submitted by him to the Rivers and Harbors Committee of Congress, a copy of which paper appears herewith as Appendix K<sup>a</sup> (see pp. 50 and 51 of said pamphlet).

---

<sup>a</sup> Printed in part only.

It is to be specially noted, however, that the canal contemplated in the alleged agreement, if such it was, was very much smaller and less expensive than the one now proposed, the estimated cost of the canal under consideration at that time being only \$2,900,000.

With this brief statement of facts and allegations, whose weight Congress alone should decide, the Board will now return to the two general considerations upon which the question of advisability depends, namely, cost and benefits.

#### COST.

As will be seen later, the estimated cost of the proposed canal (via Shilshole Bay and University route) is \$7,422,000 (see paragraphs 51 to 57, inclusive).

The average annual cost of maintenance and operation of canals, as determined from actual figures on several existing canals, and from the estimates prepared by the Isthmian Canal Commission and by the Board of Engineers on Deep Waterways between the Great Lakes and the Atlantic Tide Waters, amounts to about  $1\frac{1}{3}$  per cent of the original cost, and the Board considers this a safe allowance for the canal in question. The estimated annual cost of maintenance and operation is therefore \$98,960.

In order that the construction of the canal may be advisable there should be a reasonable prospect that the direct and indirect benefits accruing therefrom would cover not only this cost of maintenance and operation, but also a moderate interest on the capital invested. If interest be computed at the minimum rate of 2 per cent, it will amount to \$148,440 per annum.

Therefore, unless there is a reasonable prospect that the benefits, direct and indirect, immediate or prospective, would amount to at least \$247,400, or, in round numbers, a quarter of a million dollars per annum, the construction of the canal by the General Government can not be considered advisable.

#### BENEFITS.

The benefits that would result from the construction of the canal would all come under two general heads, namely, naval and commercial.

#### NAVAL ADVANTAGES OF THE PROPOSED CANAL.

Feeling that the Navy Department should decide as to the true naval value of the proposed canal, the Board on September 2, 1902, addressed a letter to the Chief of Engineers, U. S. Army, requesting that an expression of the views of the Navy Department on this question should be obtained. This letter was referred to the honorable Secretary of the Navy and by him to the chiefs of the Bureaus of Steam Engineering, Yards and Docks, Construction and Repair, Ordnance, Navigation, and Equipment, each of whom placed an indorsement thereon.

These officers all concurred in the opinion that there is no necessity, from a naval standpoint, for the construction of the proposed canal at the present time.

Therefore the Board decided, with this information before it, that so far as the Navy is concerned the canal can not be considered a present necessity.

## COMMERCIAL ADVANTAGES OF THE PROPOSED CANAL.

The proposed canal, by affording entrance into Lakes Union and Washington, would add many miles to the present water front of the city of Seattle, and thus afford unlimited wharfage room, as well as unlimited anchorage in fresh water, perfectly protected from storms; the construction and maintenance of wharves would be much less expensive than on the present water front, where the depth of water is very great and where the teredo is especially destructive; vessels lying at wharves would be free from tidal oscillations, and hence the cost of taking on or discharging cargo would be less than in the Sound, where the mean tidal oscillation is about 12 feet; and vessels, whether lying at wharf or at anchor, would have the advantage of being in fresh water. In addition to these benefits a few local industries, of which coal production is the most important, would receive the benefit of being brought nearer to their shipping point.

The above are the chief commercial advantages that would follow the construction of the canal, and they will be briefly discussed in succession.

*Increased wharfage room.*—The commerce of Seattle is already large, and is increasing very rapidly. The present water front of the city is limited in extent, being cut off by the tide flats on the south and by bluffs or hills on the north. If the commerce of the port continues to grow as rapidly as it has in the last few years the wharfage room may become overtaxed; but it can scarcely be claimed that this is the case at present. It seldom, if ever, happens that all or even a majority of the present wharves are occupied at the same time, and but few vessels are required to lie at anchor for any great length of time while awaiting a berth.

*Increased and safer anchorage room.*—The water in Elliott Bay is so very deep that it is not safe for a vessel to anchor, and therefore mooring buoys have to be provided. This of course restricts the anchorage room to such points as may be provided with these buoys, and, on account of occasional severe storms, vessels thus moored are not always safe. But, as stated above, so few vessels are forced to lie at anchor that the providing of additional anchorage room is not yet a necessity; and if it were, it could be done far less expensively than by constructing a canal into Lakes Union and Washington.

*Decreased cost of constructing and maintaining wharves.*—It is not to be denied that, on account of the very rapid deepening of the water in Elliott Bay, the construction of wharves is unusually expensive, and that on account of the great activity of marine insects in these waters, the piles, unless treated, last but a comparatively short time. This disadvantage, however, is largely offset by the abundance and cheapness of lumber in that region. Furthermore, it is questionable whether the general public would receive enough benefit from the decreased cost of wharves to justify the Government in expending money with that object in view.

*Absence of tidal oscillations and consequent decrease in the cost of loading and unloading vessels.*—The great range of tide level in the Sound may, and doubtless does, increase, in some measure, the cost of handling cargoes; but this increase is not thought to be very material. In fact, the stevedore rates are not now perceptibly higher in Seattle than in San Francisco, where the mean range of tides is only about  $4\frac{1}{2}$  feet.

*Benefits to the coal mines and other local industries.*—There are a number of coal mines of greater or less importance whose output is now shipped to Seattle. About one-half of the present output is consumed in Seattle, the other half being shipped principally to Alaska, California, and Hawaii. The present output of the mines now tributary to Seattle is reported by the company that handles most of it to be about 990,364 short tons per year.

These mines are much nearer to Lake Washington than to Seattle, and hence if the canal were built Lake Washington would naturally become the shipping point for much of this coal.

But the length of haul from the mines to Seattle is so short (the average haul being only about 30 miles or less) that a decrease in the distance would not by any means effect a proportionate decrease in freight rates. Freight charges would doubtlessly be decreased in a measure, and for the reasons stated above the cost of construction and maintenance of bunkers on the lake would be less than on Elliott Bay. The cost of shipping being reduced, the output would probably be somewhat increased.

But the total quantity of coal shipped is not very great, and the quality of the coal is such that the demand for it is necessarily limited. It is not probable, therefore, that the increased production of coal or the decreased cost of shipping it would result in benefits to the general public at all commensurate with the cost of the proposed canal.

A similar conclusion must be reached with reference to the other local industries in question.

#### SUMMARY.

The Board considers, therefore, that the demands of commerce are not at all adequate at the present time to warrant the construction of the proposed canal, and as the Navy Department holds that there is no necessity for the canal from a naval standpoint, the Board is of the opinion that the construction of the proposed canal at the present time is not advisable.

This conclusion is reached without giving any weight, on either side of the scale, to the question of the Government's alleged obligation in the matter which, as above stated, the Board does not feel called upon to consider.

Under date of November 19, 1902, a committee of the Seattle Chamber of Commerce submitted to the Board the suggestion that if the construction of the entire canal were found too expensive to be undertaken as a whole, the project could be modified by the omission, at present, of that portion of the canal connecting Lake Union with Lake Washington, thus largely reducing the cost of the project while preserving its chief advantages. The document containing this suggestion is appended hereto as Appendix A 2.<sup>a</sup>

The Board has carefully considered the proposed modification; but while a canal of the required dimensions terminating in Lake Union would cost but little more than half the cost of the entire canal, the Board is of the opinion that the commercial benefits would be reduced in even greater proportion than the cost, and that the value of the canal to the Navy would also undoubtedly be reduced, in some degree at least.

Therefore the Board considers that the construction of the canal to Lake Union only is also, at the present time, not advisable.

---

<sup>a</sup> Not reprinted; printed in Senate Document No. 127, Fifty-seventh Congress, second session.

## PLANS AND ESTIMATES.

As stated in paragraph 7 the Board decided, after careful consideration, that the dimensions of the canal contemplated by Major Millis, Corps of Engineers, in his estimate of January 10, 1902, would meet the requirements of the canal the Board is directed to report upon; but it was thought best to introduce certain minor modifications in the route and general arrangement.

The principal change is the adoption of what is called the University route, instead of the Portage route, between Lake Union and Lake Washington. This change increases the cost somewhat; but, as it eliminates a very objectionable curve, the additional cost is thought justifiable. The change necessitates procuring the new right of way, but this would probably not be difficult, since the land through which the proposed route passes is owned by the State of Washington, being part of the grounds occupied by the State University. This land is now covered with woods, and no buildings or other improvements would be damaged.

Another change is the proposed adoption of regulating works for the purpose of maintaining Lake Washington at its low-water level. The lowering of Lake Washington to the level of Lake Union has often been urged, the chief advantages claimed by the advocates of this measure being that the lock between these two lakes could thereby be dispensed with, and that much lowland which is now flooded when Lake Washington is high would be reclaimed. But while the lock between the lakes would not be necessary if this change were effected, the amount of dredging and excavation would be very greatly increased, and, in addition, the question of damages to parties now owning land on Lake Washington would have to be met. Hence the board does not favorably consider the lowering of Lake Washington to the level of Lake Union, and the estimates do not contemplate such a change.

But as much benefit would result to inundated lands, and the necessary height of lock walls and gates would be reduced by maintaining Lake Washington at its low-water level, and as this can be effected at moderate expense, an estimate of the cost of the necessary regulating works, which could be placed in the present portage cut, is included in the estimate.

Major Millis was requested by the Board to prepare an estimate incorporating the above changes and making such modifications in unit prices as the work already done would warrant.

Having carefully considered the estimate thus prepared by Major Millis, the Board decided to adopt it, making no modifications except the addition of 15 per cent to cover contingencies.

The following, therefore, is the Board's estimate of the cost of the proposed canal by the Shilshole Bay and University route. A map showing the proposed route, as well as the Portage route, appears herewith as Appendix N.<sup>a</sup>

Dredging in Shilshole Bay, 1,616,000 cubic yards, at 35 cents.....	\$565,600.00
Lower lock and dam complete, including lock excavation.....	2,067,981.00
Salmon Bay from lower lock to head of Salmon Bay, dredging 1,188,000 cubic yards, at 30 cents.....	356,400.00
Excavation between head of Salmon Bay and Lake Union, 1,206,400 cubic yards, at 33 cents.....	398,112.00
Dredging in Lake Union, 954,056 cubic yards, at 25 cents.....	238,514.00

<sup>a</sup>Not reprinted; printed in Senate Document No. 127, Fifty-seventh Congress, second session.

## 2352 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

Upper lock complete, including lock excavation.....	\$2, 164, 359.00
Excavation between Lakes Union and Washington, 689,338 cubic yards, at 40 cents .....	275, 785.00
Lake Washington, dredging 1,156,116 cubic yards, at 30 cents .....	346, 835.00
Regulating works in Portage cut.....	40, 000.00
Contingencies .....	968, 022.90

Total..... 7, 421, 508.90

Or, in round numbers, \$7,422,000.

The corresponding estimate following the Portage route instead of the University route would be \$7,399,000.

It is to be noted that the above estimates contemplate placing the outer sill of the lower lock 25 feet below extreme low tide, as in the plan submitted by Major Millis on January 10, 1902. It also contemplates dredging the approach to the lock to the same depth, providing, just west of the lock, a waiting basin whose depth is 34 feet below extreme low tide.

This arrangement is open to the objection that vessels drawing more than 24 feet of water would be unable to pass the lock or to pass between the Sound and the waiting basin at extreme low tide, and vessels of 34 feet draft would be able to pass only when the tide level was at least 10 feet above extreme low tide. Vessels of intermediate draft could of course pass at intermediate stages of the tide; but twice every day the canal and its approach would be inaccessible to all vessels of maximum drafts, the length of these periods of inaccessibility increasing with the draft of the vessel.

To entirely overcome this objection it would be necessary to lower the outer sill of the Shilshole Bay lock to a depth 34 feet below extreme low water, and to dredge the approach to the lock to the same depth. It is estimated that the additional cost, in round numbers, due to placing the sill of the lock at this level would be \$406,000, and that the additional cost of dredging the approach to this depth would be \$226,000, or, adding 15 per cent for contingencies, \$726,800 for both. The estimated cost of the canal with these modifications introduced would, therefore, be \$8,148,800 for the University route, or \$8,125,800 for the Portage route.

## SOUTH CANAL.

The Board is also directed to "examine the route for a similar canal connecting Elliott Bay with lakes Union and Washington, with a view to determine the feasibility of such route." \* \* \*

This is the route over which the Seattle and Lake Washington Waterway Company proposes to construct its contemplated canal. It is locally known as the "southern route," to distinguish it from the routes through Lake Union, which are referred to collectively as the "northern route."

The Seattle and Lake Washington Waterway Company is a corporation which, under the provisions of an act of the legislature of the State of Washington, has contracts with the said State for filling in and reclaiming the tide flats south of the city of Seattle, for excavating certain waterways through these tide flats, and for excavating and constructing a canal, with the necessary locks, connecting Elliott Bay with Lake Washington.

The following brief history of the company and its plans, compiled from a pamphlet furnished by the company (copy of which is forwarded

herewith as Appendix E 2<sup>a</sup>), is given to facilitate a better understanding of the project.

The general plans for cutting the canal, excavating waterways, and using the material in filling the flats were first formulated in 1890, by Eugene Semple. In 1893 the legislature of Washington passed an act for the excavation of waterways by private contract. The following is an analysis of this act:

ANALYSIS OF THE ACT OF MARCH 9, 1893, WHICH PROVIDES FOR THE EXCAVATION OF WATERWAYS BY PRIVATE CONTRACT.

It authorizes any person or company to excavate waterways through the tide and shore lands belonging to the State, and with the material to fill in above high tide any land and shore lands in front of incorporated cities, or within 1 mile on either side.

It gives to the person or company performing the work a first lien upon all such lands as they may fill in, for the cost of the work, with 15 per cent additional thereon.

It authorizes streets and public places to be filled in, and bulkheads and restraining works to be constructed, and the cost thereof, with 15 per cent additional, to be added to the lien on the lands benefited thereby.

The liens attach and certificates are issued therefor from time to time as the work progresses upon the waterways.

The liens are a first mortgage on the lands, subject in case of default to foreclosure, as other mortgages on real estate. They bear 8 per cent interest from date of issue and are payable in ten equal annual installments, the first payment being one year from the date of the sale by the State.

The lands covered by any contract are held subject to the ultimate lien of the contractor and are sold by the State subject to this lien, the purchaser assuming the payment of the same whenever it attaches.

The waterways excavated are free, except where locks or tide gates are necessary, when a reasonable toll may be charged.

The contractor has the option for six months to purchase, at the appraised value, all lands that have not been sold by the State within one year after such lands have been filled in.

The bill having become law, Eugene Semple, of Seattle, applied for a contract to construct a waterway, etc., and such contract was made, dated October 27, 1894, and to carry it out the Seattle and Lake Washington Waterway Company was organized.

By this and three similar contracts, with the supplements thereto, the State of Washington, as the party of the first part, authorizes the party of the second part to excavate the waterways and canal in question, to construct and operate thereon "locks of stone or wood and iron, or stone and wood and iron, of ample capacity to pass vessels of 300 feet keel, 25 feet beam, and 22 feet draft through said waterway from Elliott Bay to Lake Washington, and to charge reasonable tolls for passing vessels through said locks until such time as the government of the State of Washington or the Government of the United States shall appropriate said locks in the manner provided by law." It also authorizes said party of the first part to fill in certain designated tide lands near Seattle and agrees that upon the execution of said contract, in whole or in part, by the party of the second part it will grant to said party of the second part a lien upon said tide and shore lands, as provided in the above-mentioned act of the legislature; and the party of the second part agrees to perform the acts above mentioned, to begin the work contemplated in each contract within six months of the date of signing said contract, and to complete it within six years of the same date.

---

<sup>a</sup> Not printed.

The last of these four contracts was signed on April 10, 1895, and hence the last of the work should, by the terms of the contracts, have been completed by April, 1901. But the time for the completion of each contract has been extended until October 27, 1904, and the company thinks it can obtain such further extensions as may be necessary. Copies of the contracts above referred to are herewith as Appendixes M 1<sup>a</sup>, M 2<sup>a</sup>, M 3<sup>a</sup>, and M 4<sup>a</sup>.

In order to finance the scheme a trust company notified the Waterway Company that it was ready to advance funds for the work upon compliance with certain conditions, one of which was that the citizens of Seattle should raise a subsidy of half a million dollars, payable on completion and formal opening of said ship canal. This subsidy was raised, it being stated that the subsidy list contains "the names of 2,468 of the leading business men of Seattle, including all the banks."

Pursuant to its contracts this company has already excavated a portion of the required waterways, filled in a portion of the designated tide-shore lands, and has begun the excavation of the proposed canal. The latter work is done by the hydraulic process, the excavated material being carried off in sluices and deposited on the tide flats.

In compliance with the order, the Board examined the route in question and reports as follows in regard to its feasibility:

The word feasible is defined by the Century Dictionary to mean "Capable of being done, performed, or effected; that may be accomplished or carried out; practically possible" \* \* \* and by the Standard Dictionary to mean, "That may be done, performed, or effected; practicable."

While, as stated above, the Board considers that there is a deficiency of information regarding the character of material to be encountered on the route now in question, it nevertheless believes the route to be feasible under the above definitions of that word.

This route, which is commonly known as the southern route, to distinguish it from the northern or Shilshole Bay route, starts in an artificial channel, or "waterway," in the tide flats south of Seattle Harbor, and runs in a straight line across the highlands to Lake Washington. It cuts through a wide ridge which rises to a height of more than 300 feet above low water in the Sound, and then through another ridge more than 150 feet in height.

From this it will be readily seen that the quantity of material to be excavated is enormous, and that the cut must have prodigious dimensions.

If the canal be made to afford accommodations similar to those afforded by the proposed canal via Shilshole Bay, and if the sides of the cut be given a slope of 1 vertical on 1½ horizontal, which the Board considers the maximum slope consistent with stability and safety, the amount of material to be excavated, including that from the canal approaches, will approximate 35,500,000 cubic yards (as opposed to about 7,740,000 by the Shilshole Bay route), and the cut at its widest point will be about 1,150 feet in width and more than 300 feet in depth.

When it is considered that all the land through which this cut is to pass is already laid out for streets and city lots, and that the route is already crossed by a number of streets, an electric road, two or more wagon roads, and the water main that supplies the city of Seattle with

---

\*Not reprinted; printed in Senate Doc. No. 27, Fifty-seventh Congress, second session.



water, and therefore that suitable crossings or bridges would have to be provided over this chasm, not only for the roads, water main, and part of the streets already in existence, but for at least a portion of the streets that will certainly be there at no very distant date, it is seen that the cost and difficulties are practically prohibitive.

Furthermore, the approach to this canal is now crossed by the main line of the Northern Pacific Railroad, and most of the tracks for shifting freight cars will probably cross it sooner or later.

For the above reasons, while the Board deems this route "feasible," in the broad sense of that term, it considers that the difficulties and objections are so great as to make it almost impracticable as that word is ordinarily employed in business.

In compliance with the order, the Board invited the Seattle and Lake Washington Waterway Company to submit proposals for constructing a similar canal over the route in question, and similar proposals for connecting Elliott Bay with Lake Union through Lake Washington.

In order that the proposals should be for "similar" canals, the Board designated dimensions that would provide practically the same accommodations as the proposed canal by the Shilshole Bay route, and designated the slopes, etc., necessary to make the embankment safe. The letters inviting these proposals and the proposals, with the letter transmitting them to the Board, are appended hereto as Appendixes F,<sup>a</sup> F 1,<sup>a</sup> F 2,<sup>a</sup> G,<sup>a</sup> H,<sup>a</sup> I,<sup>a</sup> and J.<sup>a</sup>

It will be noted that the Waterway Company submitted two sets of proposals, one based on the dimensions specified by the Board and the other upon much smaller dimensions, which the Waterway Company thinks sufficient.

These proposals may be tabulated as follows:

	Canal affording the same accommodations as the proposed canal via Shilshole Bay.	Smaller canal proposed by Seattle and Lake Washington Waterway Co.
Connecting Puget Sound with Lake Washington.....	\$3,304,121	\$3,968,195
Connecting Lake Washington with Lake Union.....	2,375,628	1,013,982
Total .....	10,679,747	4,982,127

It will be seen upon examination that both proposals for the canal between Elliott Bay and Lake Washington contemplate a lock consisting of concrete and timber cribbing, instead of concrete alone, as contemplated in the Board's estimate for the northern canal, and that both contemplate gates of timber instead of iron and steel as contemplated by the Board. It will also be noted that the principal proposal for the canal connecting Lakes Washington and Union is identical with Major Millis's estimate of January, 1902, for this portion of the northern canal, but that the alternative proposal contemplates raising Lake Union to the level of Lake Washington, resulting damages to be paid by the United States.

The amount of these damages could not be determined in advance without securing releases from the property owners concerned, and

<sup>a</sup> Not reprinted; printed in Senate Doc. No. 127, Fifty-seventh Congress, second session.

these releases probably could not be secured without resorting to condemnation proceedings.

It should also be observed in this connection that, as stated above, the cut between Elliott Bay and Lake Washington, if given the side slopes considered necessary for safety, will be in some places 1,150 feet in width, while the Waterway Company is authorized by law to condemn a right of way only 1,000 feet in width.

The Board is informed that the Waterway Company has as yet acquired only a small portion of its right of way, and has taken no steps to acquire the remainder. Land along this route is, of course, rapidly advancing in value, and the cost of this right of way will be a very considerable item. A strip 1,000 feet in width throughout the length of the canal would cover about 230 acres, and it is estimated that a strip of irregular width, conforming to the actual width of the cut with the prescribed slopes of 1 on  $1\frac{1}{2}$ , will cover about 165 acres.

The above-named proposals make no reference to the question of bond or other security, or to the crossings that would have to be provided over the canal in case the United States should accept one of said proposals. Therefore, on September 18, 1902, the Board addressed a letter to the Waterway Company covering these points, and received a reply, which is forwarded herewith as Appendix E 16.

The substance of this reply is that the company would furnish good and sufficient bond, and that it would comply with any requirements of bridge construction that might be decreed against them, but that the burden of bridge maintenance would not fall upon them.

#### RELATIVE ADVANTAGES OF ALL PROPOSED ROUTES.

The last point the Board is directed to report upon, namely, "the relative advantages of all proposed routes," has doubtless been sufficiently covered by the foregoing remarks, and hence will not be discussed at length. It may be stated briefly, however, that—

First. Of the various northern routes that by Shilshole Bay is, for reasons given, the most advantageous.

Second. The southern route is shorter and more direct, and free from curves except at the junction between the so-called east waterway and the canal waterway, where a change in direction of  $90^\circ$  is made.

Third. By the southern route Lake Washington can be reached with only one lockage instead of two, as on the Shilshole Bay route.

Fourth. The southern route would be somewhat more convenient for vessels going from the present water front of the city to the lakes and vice versa.

Fifth. The size of the cut, the amount of material to be excavated, the probable difficulty of maintaining the slopes, the enormous cost of the crossings that would have to be constructed, the cost of procuring right of way, and the fact that this right of way has not yet been procured, make the difficulties and cost of constructing a canal by the southern route almost prohibitive.

Sixth. The approach to this route is crossed by the Duwamish River, a silt-bearing stream, and therefore frequent, if not constant, dredging would probably be required to keep this approach at the required depth.

Seventh. This route would be somewhat less exposed to the attack of an approaching hostile fleet, but far more exposed after the fleet reached a point from which the lock could be shelled.

Eighth. A canal on this route would be in much greater danger of being closed by slides than one by the northern route.

Ninth. In view of all the above facts, the Board considers the Shilshole Bay route as the most advantageous of all proposed routes.

#### RECAPITULATION.

The conclusions of the Board on the various matters it is required by the order to consider may be briefly summarized as follows:

First. The construction of "a canal, with necessary locks and dams, connecting Puget Sound with Lakes Union and Washington, of sufficient width and depth to accommodate the largest commercial and naval vessels," is feasible.

Second. It is not advisable at the present time.

Third. The estimated cost of such canal is \$7,422,000.

Fourth. The route for a similar canal connecting Elliott Bay with Lakes Washington and Union is feasible, but the cost and difficulties are almost prohibitive.

Fifth. The proposal of the Seattle and Lake Washington Waterway Company for the construction of a canal of the required dimensions, connecting Elliott Bay with Lake Washington, is \$8,304,121.

Sixth. Their proposal for connecting Elliott Bay with Lake Union, through Lake Washington, is \$10,679,747.

Seventh. The Shilshole Bay route is the most advantageous of all proposed routes.

Respectfully submitted.

W. H. HEUER,  
*Lieut. Col., Corps of Engineers.*

W. C. LANGFITT,  
*Captain, Corps of Engineers.*

ROBERT P. JOHNSTON,  
*First Lieut., Corps of Engineers.*

Brig. Gen. G. L. GILLESPIE,  
*Chief of Engineers, U. S. Army.*



## APPENDIX Z Z.

---

### SUPERVISION OF THE HARBOR OF NEW YORK.

---

REPORT OF COMMANDER E. F. QUALTROUGH, SUPERVISOR, FOR THE  
FISCAL YEAR ENDING JUNE 30, 1903.

WAR DEPARTMENT,  
OFFICE SUPERVISOR OF HARBOR OF NEW YORK,  
*New York, July 14, 1903.*

GENERAL: I have the honor to submit the following report of the duties and operations of this office for the fiscal year ending June 30, 1903, together with an estimate of the amount required for the fiscal year ending June 30, 1905.

Since the preceding annual report there has been no material change in the system of patrol or the method of checking adopted for keeping under strict supervision the movement of waste material upon the waters of the harbor and those tributary or adjacent thereto, amounting to upward of 20,000,000 cubic yards during the past fiscal year, indicating the necessity of a sufficient number of vessels in the service to keep this vast amount of waste under surveillance.

The number of patrol vessels at present consists of 5 steam tugs and 1 naphtha launch.

Four of the tugs are utilized in maintaining a permanent patrol of the bay and harbor, as far out at sea as Sandy Hook light-ship, which is the point to the south and east of which the deposit of any material at the mouth of the harbor must now take place, except so far as relates to the disposition of material dredged from the east channel, which is deposited in an average of 95 feet of water off Scotland light-ship. The other tug patrols the Hudson and East rivers, and Long Island Sound when operations in that direction are of sufficient magnitude to warrant it, while the naphtha launch looks out for the Staten Island kills, Newark Bay, Passaic River, and shallow tributaries.

These vessels are also required to enforce the provisions of the act of Congress approved August 18, 1894, in keeping the main channels free from small craft engaged in fishing or dredging for shellfish, or in any way interfering with the safe navigation of those channels by ocean steamships and vessels of deep draft.

In the course of performing these duties they have during the past year frequently rendered important and valuable services in saving life and property, and in this connection I had the pleasure of presenting to Irving P. Grace, master of the U. S. tug *Lamont*, a silver life-saving medal, awarded to him under acts of Congress of June 20,

1874, and May 4, 1882, in recognition of heroic conduct in saving life from the perils of the sea, together with a letter from the Secretary of the Treasury transmitting same.

The importance of this patrol to the Government and the commercial interests of the port can not be overestimated, and its efficiency will be very much enhanced by the addition of the new seagoing vessel authorized under the appropriation for the next fiscal year.

This new vessel is intended to replace the *Argus*, which has been on patrol duty as an inside boat and kept running under many difficulties. Nevertheless I am of the opinion that it would prove more economical to retain the latter in the service as a spare boat, for some time at least, rather than to incur the sacrifice of a sale at auction, in view of the fact that a considerable sum has just been expended on her to keep her serviceable, and she is now in a reasonably fair condition. The maintenance of such a spare boat would cost very little from the fact that through the courtesy of the city department of docks and ferries the vessels of this office are permitted to wharf free of charge, and I see no reason why the city should at any time withdraw these privileges, since the patrol vessels are performing duties which conduce largely to the welfare and prosperity of the harbor. For these reasons it is economy to retain her in the service as an auxiliary, and by keeping only two ship keepers on board the cost would be comparatively trifling, and in case of her services being needed the crew of the broken-down patroller could be transferred to her without delay, and a permanent patrol of the harbor be thus maintained. It is to be regretted, yet it is nevertheless a fact, that the slightest break in the continuity of the patrol service is taken advantage of by unscrupulous contractors and others engaged in transportation of waste material upon the waters of the harbor, and it is a well-established maxim that no steamboat line can be properly handled without an extra boat, and the same applies to this service. I have therefore included a small amount for the maintenance of the *Argus* as a spare boat.

I also find it necessary to add slightly to the former estimates required for the running expenses of the patrol vessels, due to the continued high price at which coal is maintained, the estimate being drawn for the economical running expenses of the boats, including slight minor emergency repairs, extensive repairs being asked for in special estimates.

The strike in the coal fields in the past fiscal year caused an enormous increase in the cost of the coal, and as a consequence many important minor repairs had to be temporarily patched in order to eke out a crippled existence in maintaining the patrol. However, Congress, by an additional appropriation of \$10,000, authorized under the deficiency bill approved March 3, 1903, eased the situation toward the close of the year; but the vessels were so far run down before funds became available that urgent and extensive repairs were absolutely necessary on each boat during such periods as they could be spared off patrol duty. However, these vessels, except the *Lamont*, are now all in fairly good condition, and it is expected that the funds appropriated for the ensuing fiscal year will be sufficient for their proper maintenance.

The launches *Active* and *Alert* having outlived their usefulness in this service, being obsolete, worn-out, unfit for further service, and a source of expense for storage, were condemned to be sold, and were

disposed of to the highest bidder, realizing the sum of \$460, which was duly deposited to the credit of the Treasurer of the United States.

The extension of the limits outside the harbor within which the deposit of material must not take place entails considerable additional cost for towing so far out to sea, but has resulted in the utilization of much of this class of material for filling in behind permanent bulkheads and reclaiming land, particularly so on Jersey flats at Greenville for the Pennsylvania Railroad Company, the tide-water flats at Port Liberty for the Central Railroad Company of New Jersey, at Governors Island for the United States, and at Rikers Island for the department of street cleaning.

Some effective method of putting a stop to the gradual leakage of material while in transit has been the subject of careful attention for some years. While such leakage from a single tow can do but little harm, the aggregate during a year may prove of serious injury to the channels. It is therefore satisfactory to note that this evil is being gradually brought under control by the check system referred to, discrepancies in the condition of the scows when loaded and after reaching the point of final disposition are noted, and the party for whom the work is being done notified, and payment for the material lost in transit, as shown by such discrepancy, is deducted from the account of the contractor. Such action would, of course, be impracticable were it not for the clause now generally adopted in all contracts for excavation or deposit of material, that "the material must be disposed of in accordance with law, and that any material improperly disposed of will not be paid for," and upon information furnished by this office of the slightest violation of that clause deductions are properly and promptly made, thus removing any advantage which might accrue to the contractor by the escape of material in transit. Material failing to clear at the proper point for deposit must also be accounted for by the contractor, either by return to the point of loading to be there measured and proper deductions made, or disposed of under a new permit issued by this office.

During the past fiscal year there have been a number of instances where payments for material dredged have been held up because of the failure of tows to reach the proper point of deposit, the loss of the material being due to carelessness of the people employed or to accident, such as the breaking of the door chains, getting ashore, or collision; and where the deposit could be definitely located, the contractors have generally preferred to send a plant to the point indicated and redredge the material rather than suffer the deductions. The material so redredged amounted to 3,937 cubic yards during the past fiscal year.

I have gone into the detail of the system of checking because of its importance in carrying out the intention of the acts of Congress under which this office operates, and I am satisfied that its further development will eventually put a stop to such minor violations as can not well be referred for action of the courts because of lack of sufficient evidence to warrant such expensive procedure, as the corpus delicti must be proved, no matter how irresistible the inference may be. Of course in cases where the system of checking is inapplicable special efforts are made to obtain the desired evidence, or where deliberate and persistent disregard of the law and regulations is in evidence the

case is promptly referred to the Department of Justice with recommendations that proceedings be instituted with a view to the prosecution of the parties liable.

It is satisfactory to note that during the past fiscal year there were but three serious cases of violation requiring action by the United States district attorney; and it is found, as stated in my previous report, that the law being now thoroughly established by numerous trials of cases in the United States courts, together with the provisions of section 12, river and harbor act approved June 13, 1902, owners of plants and tugboats and others interested realize the efficiency of the measures adopted by the Government for the protection of the harbor channels and are more careful to avoid violation.

The importance of the check system above referred to may be more clearly demonstrated by reference to the following table showing deductions made on contracts for material escaping from inefficient dumpers, which had failed to clear at the proper point for deposit, due to refractory material or defective machinery, and the proper deductions made before reloading, from July 1, 1902, to June 30, 1903:

	Cubic yards.
United States Engineer Department .....	11,545
Department of Docks and Ferries .....	5,133
Private contracts .....	5,829
Street-cleaning department .....	550
Navy Department .....	259

23,316

at an estimated average of 20 cents per cubic yard, amounting to \$4,663.20.

Under the same contracts 142 pocket loads (averaging 150 cubic yards each, or a total of 21,300 cubic yards) were noted by the patrol boats as taken out to sea, where, failing to clear at the proper place of deposit, they were kept under surveillance until returned to the original point of loading, and there deducted before reloading. This amount of material would have proved a large item of gain to the contractor could it have been disposed of on the way in, without the knowledge of this office, and before reaching the supervision of the parties for whom the work was done, the contractor not only having to bear the expense of retowing it to sea, but very frequently having to dredge it before being able to properly dispose of it.

The entire garbage of the city being disposed of by reduction on Barren Island, 255,300 cubic yards having been disposed of in this manner during the past fiscal year, its transportation over the waters of the harbor has been kept under strict supervision by this office to prevent loss in transit from improper trimming and careless handling. The greater part of the waste from the city proper, being what is commonly termed "street sweepings," was disposed of at sea until about May 12 last, since which date it has been used for filling in behind bulkheads. The records show that this office has for many years persistently urged the city authorities to employ some more satisfactory and sanitary method for the final disposition of its waste material than by dumping it at the mouth of the harbor, and it is now thought that the street-cleaning department has at last solved the problem by separation, cremation, and the final disposition of the remaining material on shore, which must prove a great relief to the harbor and shores of the summer resorts in the vicinity, as these beaches, the pleasure resorts of thousands of the citizens, were the principal sufferers, because of the



floatable nature of material so disposed of by the city under the head of "street sweepings."

It will be seen by a reference to previous reports of the office that its progress in protecting the channels and the waters from floating débris has been steadily progressive, and in continuing the policy I found that vessels entering and leaving the port were exceedingly careless in disposing of their waste when "cleaning up," and believing that the evil could best be corrected by the cooperation of the owners and agents, the following circular letter was issued and sent to all shipping agents and steamship lines in this city, being acknowledged in each case with assurances of hearty support and cooperation.

WAR DEPARTMENT,  
OFFICE OF THE SUPERVISOR OF THE HARBOR OF NEW YORK,  
New York, January 8, 1903.

The deposit in the tidal waters of New York Harbor, or tributary waters thereto, of refuse of any kind, whether sinkable or floatable, from wharves or vessels of any description, is a misdemeanor punishable by fine or imprisonment, or both.

There appears to be no doubt that much of the fouling of the beaches in this vicinity is due to the practice, which is quite general, of discharging refuse from steamers, both outgoing and incoming, inside the Sandy Hook light-ship.

If stringent orders should be issued by all the owners or agents to the masters of their vessels to avoid discharging any refuse inside the 20-mile limit, the result would be a marked improvement in the condition of the channels and beaches, and I therefore urgently request that you will give such instructions to the vessels under your control.

Without the energetic cooperation of the shipping people themselves this office can hardly succeed in stopping this practice.

Trusting you will give the matter the earnest attention it deserves, I remain,  
Very respectfully,

E. F. QUALTROUGH,  
Commander, U. S. Navy, Supervisor of Harbor.

The following is a synopsis of the cases of illegal dumping which have been referred to the United States district attorney during the past fiscal year, with a recommendation by this office that legal proceedings be instituted against the parties liable.

#### CASE AGAINST THE TUG "GEORGE D. KUPER."

[United States v. James Pierce and Sigar.]

In this case dumper No. 19, a 10-pocket scow, was reported loaded with dredging spoils from Bay Ridge channel December 9, 1902, and was towed to sea by the tug *George D. Kuper*, James Pierce, master, on the afternoon of the 10th, and while off Owls Head, about 7 p. m., bound out, this tow was inspected by the patrol boat and the dumper then found to have 2 pockets empty. About half an hour later this tow was again inspected while off the Red dock, when the dumper was found to have 7 pockets empty. It was therefore clear that the contents of 7 of the pockets of this dumper must have been illegally disposed of in the waters of the harbor between the point of loading and a point off the Red dock. I fully investigated this case and found the evidence of illegal dumping sufficiently conclusive to warrant a reference of the case to the United States district attorney for his action.

January 13, 1903: Grand jury filed indictment.

January 30, 1903: Pierce pleads guilty. Nol. pros. as to Sigar (scowman). Pierce pays fine of \$250 and is discharged from custody. Case closed.

## CASES AGAINST THE TUG "JOHN FLEMING."

[United States v. Charles A. Brown, John Fleming, owners; William Kelly, master; John Johnson and William Erickson, scowmen.]

*Case No. 1.*—The tug *John Fleming*, William Kelly, master, passed the Narrows bound out to sea about 1.50 a. m. December 3, 1902, having in tow dumpers Nos. 25E and 38E, fully loaded with cellar dirt, Johnson and Erickson, scowmen. This tow was again inspected by the patrol boat about 6 a. m. of that date, while the tow was passing the Narrows bound in, when No. 38E was found to be empty, while No. 25E had the forward middle pocket empty and the three other pockets loaded, the entire contents of dumper No. 38E and one pocket of dumper No. 25E having been illegally deposited in the waters of the harbor between the Narrows and buoy No. 6, East Channel. The weather at the time was reported as blowing a southeast gale and a very heavy sea running.

*Case No. 2.*—The tug *John Fleming*, William Kelly, master, passed to sea having in tow the dumper *Suir*, fully loaded with cellar dirt, scowman Erickson, on the morning of January 3, 1903. This tow was inspected by the inside patrol boat while passing the fort, bound out, about 2.40 a. m. of that date, when the *Suir* was found loaded. The patrol boat on outside duty sighted the *Fleming* with her tow at a point between the light-ship and the sea buoy about 5 a. m., and upon approaching the tow and inspecting the same at a point about 1½ miles northwest of the light-ship the dumper was found entirely empty. There was a heavy sea running at the time and blowing a gale from the eastward.

Upon investigating the foregoing cases I found the scowmen could but very imperfectly understand English, the dumpers were not furnished with proper facilities for battening down the hatches, and that the master showed bad judgment in proceeding to sea with his tow under the weather conditions then existing. The cases were therefore referred to the United States district attorney for the southern district of New York for his action, advising him as follows:

The criminal prosecution of the parties liable in such cases seems to me the only method by which this class of violations of law can be stopped, and emphasizes the necessity for the drastic statute now in force for the protection of the channels of the harbor, as when these tows proceeded to sea under unfavorable conditions of weather the owners and master assumed the hazard, and therefore ought to be held responsible.

*Case No. 1.*

May 12, 1903: Grand jury filed bill of indictment. Fleming pleads guilty and is fined \$250. Nol. pros. as to other defendants.

June 26, 1903: Fleming pays fine and case closed.

*Case No. 2.*

May 12, 1903: Grand jury filed bill of indictment. Fleming pleads guilty and is fined \$250. Nol. pros. as to other defendants.

June 26, 1903: Fleming pays fine and case closed.

UNITED STATES *v.* MICHAEL MORAN AND FRANK S. RILEY.

The following is the status of case, a synopsis of which appeared in the annual report of this office for the fiscal year ending June 30, 1901:

June 18, 1901: Grand jury filed bill.

July 30, 1901: Demurrer filed.

December 28, 1901: Opinion filed overruling demurrer.

December 30, 1901: Order filed overruling demurrer.

January 15, 1902: Trial and conviction of both defendants. Judgment suspended as to Riley. Motion for new trial and in arrest of judgment as to Moran. Motion denied; appeal to Supreme Court. Thirty days to file exceptions.

May 28, 1903: Appeal abandoned. Fine of \$250 paid by Michael Moran and case closed.

Aggregate of fines imposed and paid since last annual report, \$1,000.

## CASE AGAINST THE TUG EMMA J. KENNEDY.

The following is the status of this case, a synopsis of which appeared in the preceding annual report:

March 26, 1902: Warrant issued.

March 27, 1902: Hearing before court. Decision reserved. Held for the action of the grand jury of the eastern district of New York.

June 30, 1903. Still pending.

There has been moved and deposited outside the harbor, at properly designated places and behind bulkheads in the neighborhood of New York, during the fiscal year ending June 30, 1903, the amount of 20,460,587 cubic yards of material—mud, city refuse, garbage, cellar dirt, ashes, lime, and other material—as per the following recapitulation:

Place of deposit.	Kind of material.	Amount.
		<i>Cubic yards.</i>
Sandy Hook lightship .....	City refuse, mud, etc .....	8,317,065
Scotland lightship .....	Mud and sand .....	3,498,031
Long Island Sound .....	Mud, shells, etc .....	1,738,823
Hudson River .....	Dirt, ashes, mud, etc., behind bulkheads and on shore for filling.	401,955
East River .....	do .....	816,565
Harlem River .....	do .....	51,035
New York Bay .....	do .....	1,578,633
New York Bay (P. R. R. Co., Greenville) .....	do .....	2,961,961
New York Bay (C. R. R. Co. of N. J., Port Liberty) .....	do .....	316,570
Staten Island Sound .....	do .....	227,712
Newark Bay .....	do .....	188,735
Pasaic River .....	do .....	1,680
Hackensack River .....	do .....	1,600
Shrewsbury River .....	do .....	71,784
Raritan River .....	do .....	8,138
Barren Island .....	Garbage, dead animals, offal, etc., on shore for reduction.	255,300
<b>Total .....</b>		<b>20,460,587</b>

Permits issued, 11,598.

From the foregoing statement it will be seen that 11,845,096 cubic yards of mud, street sweepings, cellar dirt, etc., were deposited near the mouth of the harbor; 1,738,823 cubic yards of dredging spoils deposited in Long Island Sound, a large percentage of which, principally sand and shells, was utilized for the propagation of oysters, being scattered over oyster beds under supervision of the Shellfish Commission of the State of Connecticut; 6,621,368 cubic yards of cellar dirt, ashes, and other inoffensive material were used for filling in

behind bulkheads, and 255,300 cubic yards of garbage, dead animals, offal, etc., were deposited on Barren Island for reduction.

It is interesting to note that from a comparison of the records of the previous year and the fiscal year just ended there has been a decrease of about 20 per cent in the amount of material deposited at the mouth of the harbor during the past fiscal year, while during the same period there has been an increase of about 50 per cent in the amount of material utilized for filling behind bulkheads and reclaiming land.

The following is a statement of the appropriation for "Prevention of deposits, harbor of New York, 1903:"

For pay of inspectors, deputy inspectors, office force, and expenses of office.....	\$10,280.00	
Expended to June 30, 1903.....	\$9,278.03	
Outstanding liabilities.....	937.69	
	<u>10,215.72</u>	\$44.28
For pay of crews and maintenance of 5 steam tugs and 3 launches.....	70,000.00	
Expended to June 30, 1903.....	\$63,064.71	
Outstanding liabilities.....	6,587.71	
	<u>69,652.42</u>	347.58
Balance.....		391.86

The following is an estimate of appropriation required for service of the fiscal year ending June 30, 1905, by the supervisor of the harbor:

Detailed objects of expenditure, and explanations.	Estimated amount that will be required for each object.	Amount appropriated for fiscal year ending June 30, 1904.
Prevention of obstructive and injurious deposits within the harbor and adjacent waters of New York City:		
For pay of inspectors, deputy inspectors, office force, and expenses of office.....	\$10,280	\$10,280
For pay of crews and maintenance of 5 steam tugs and 3 launches.....		60,000
For pay of crews and maintenance of 6 steam tugs and 1 launch.....	63,000	5,000
For generally overhauling and repairing steam tug Lamont.....		45,000
For purchase or construction of 1 steam tug.....		
Total.....	73,280	120,280

Very respectfully, your obedient servant,

E. F. QUALTROUGH,  
Commander, U. S. Navy, Supervisor.

Brig. Gen. G. L. GILLESPIE,  
Chief of Engineers, U. S. A.

## APPENDIX A A A.

---

### ANNUAL REPORT OF THE CALIFORNIA DÉBRIS COMMISSION FOR THE FISCAL YEAR ENDING JUNE 30, 1903.

CALIFORNIA DÉBRIS COMMISSION,  
*San Francisco, Cal., July 10, 1903.*

**GENERAL:** The California Débris Commission has the honor to submit the following annual report, for the fiscal year ending June 30, 1903:

The duties of the Commission are mentioned in the summary of this report.

*Regulation of hydraulic mining.*—Since the Commission was organized in 1893, 620 applications for permits to mine have been received, and 476 permits have been issued; 302 permits have been revoked—in most cases because the mines have been worked out or abandoned or have changed hands—and 71 permits have been from time to time temporarily suspended.

During the fiscal year the Commission received 55 applications for permits or licenses to mine, 35 licenses were granted, 130 licenses were revoked, and 46 licenses were suspended.

No considerable failure of impounding barriers built or maintained under licenses given by the Commission has come to the notice of the Commission during the year.

A few cases of illegal mining were reported to the Commission during the year, and the attention of the parties concerned was called to the requirements of the law. As far as known the illegal operations have ceased in each case, and in some instances the parties concerned have subsequently applied for and obtained licenses.

Occasionally a break occurs in one of the impounding dams built under permits from the Commission, but the total number of failures has been comparatively small, and no large percentage of the débris impounded under the direction of the Commission has escaped by reason of failures of impounding works.

The total amount of material mined under permits during the year is estimated at 622,800 cubic yards.

The \$15,000 given in the following money statement as the amount that can be profitably expended in fiscal year ending June 30, 1905, is the amount which it is estimated will be required to meet the expenses of the California Débris Commission during that fiscal year in properly

regulating hydraulic mining operations in the State of California, as required by the act of Congress approved March 1, 1893:

*Money statement.*

[For appropriation of June 28, 1902, for "Expenses of California Débris Commission, 1903."]

July 1, 1902, balance unexpended .....	\$15,000.00
June 30, 1903, amount expended during fiscal year .....	9,359.87
July 1, 1903, balance unexpended .....	5,640.13
July 1, 1903, outstanding liabilities .....	843.61
Balance (reverts to Treasury) .....	4,796.52
March 3, 1903, amount appropriated for "Expenses of California Débris Commission, 1904" .....	15,000.00
Amount (estimated) required for expenses of California Débris Commission during fiscal year ending June 30, 1905 .....	15,000.00
July 1, 1903, amount expended during fiscal year from appropriation for "Expenses of California Débris Commission, 1902" .....	85.81
July 1, 1903, amount expended during fiscal year from appropriation for "Expenses of California Débris Commission, 1901" .....	89.81

*Improvement and protection of rivers.*—The duties of the Commission with reference to improving and protecting rivers and impounding mining débris are referred to in the summary of this report, as is also the project prepared and approved for the construction of impounding works on the Yuba River.

During previous years the work on the above-named project consisted chiefly in acquiring title to necessary lands, much difficulty and delay having been encountered on account of defective titles, the great number of owners that had to be dealt with, and the limited sum available for the purchase of land.

The operations during the fiscal year ending June 30, 1903, consisted principally of acquiring title to additional lands required and commencing work on the dam designated in the project above referred to as "Barrier No. 1, Yuba River." A contract for constructing the first portion of this barrier was entered into on November 3, 1902, with the Atlantic, Gulf and Pacific Company. Operations under this contract were commenced by the contractors in November, 1902, but on account of high water operations were suspended in January, 1903. One of the requirements of this contract was that the contractor should place a row of Wakefield sheet piling at or near the toe of the proposed barrier. The material in which these piles were to be placed consists of gravel, cobbles, sand, and slickens washed down from hydraulic mines and compacted by the action of running water. On account of the compactness of the material and the large percentage of cobbles and coarse gravel, it was found impracticable, within the limits of economy, to place the sheet piles without crushing and distorting them to such extent that they would be of doubtful value. This necessitated changing the plans for this portion of the work, and authority to prepare and submit for approval a supplementary contract providing for the termination of the original contract, was given by the Chief of Engineers June 18, 1903. It is proposed to forward the supplementary contract for approval at once, and to make settlement with the Atlantic, Gulf and Pacific Company for materials and services furnished under

and in connection with the original contract as soon as notice is received of approval of the supplementary contract.

The materials furnished by the Atlantic, Gulf and Pacific Company under the contract of November 3, 1902, and the amount due the contractor for same are as follows:

944 linear feet of Wakefield sheet piling, at 23 cents .....	\$217. 12
9 Wakefield sheet piles placed, at 85 cents .....	7. 65
0.93 ton of stone, at \$3. ....	2. 79
626 tons of stone, at \$2.50.....	1,565. 00
7,101 cubic yards of earth fill, at 30 cents .....	2,130. 30
757 cubic yards of gravel, at 20 cents .....	151. 40
1,815 cubic yards of loose brush, at 60 cents.....	1,089. 00
100.9 cubic yards of loose poles, at \$1.....	100. 90
<b>Total</b> .....	<b>5,264. 16</b>

On June 22, 1903, specifications for excavating about 669,000 cubic yards of material at Daguerre Point cut, Yuba River, were forwarded to the Chief of Engineers for approval, and it is proposed to advertise for proposals for this excavation work as soon as notice is received of the approval of the specifications.

On June 29, 1903, specifications for the construction of portions of barriers Nos. 1 and 2, Yuba River, were forwarded to the Chief of Engineers for approval, and authority to enter into emergency contract or contracts for the work covered by these specifications was requested. It is proposed to advertise for proposals for this work also as soon as the necessary authority is received.

Copies of the above-mentioned specifications have also been furnished to Mr. W. W. Waggoner, débris commissioner for the State of California, for consideration and examination by the State board of examiners, as provided in section 3 of the act of the legislature of California approved March 17, 1897.

Mr. Hubert Vischer, assistant engineer, has been in the employ of the Commission throughout the year, being engaged principally in the negotiations for the purchase of sites, examination of title papers, superintending the work done under the contract for barrier No. 1, Yuba River, and in making experiments in connection with the driving of sheet piles at this barrier.

#### *Money statement.*

July 1, 1902, balance unexpended .....	\$394,662. 75
June 30, 1903, amount expended during fiscal year .....	2,922. 01
July 1, 1903, balance unexpended.....	391,740. 74
July 1, 1903, outstanding liabilities .....	4,060. 52
July 1, 1903, balance available .....	387,680. 22

#### APPROPRIATIONS BY CONGRESS.

June 3, 1896 .....	\$250,000
June 13, 1902 .....	150,000
<b>Total appropriated by Congress</b> .....	<b>400,000</b>

2370 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

ABSTRACT OF CONTRACT IN FORCE DURING THE FISCAL YEAR ENDING JUNE 30, 1903, FOR  
THE CONSTRUCTION OF A PORTION OF BARRIER NO. 1, YUBA RIVER, CALIFORNIA.

Name of contractor, the Atlantic, Gulf and Pacific Company; contract approved November 13, 1902; work to be begun on or before November 28, 1902; contract to expire ninety days from date of commencement, unless suspension of work during that time be authorized. The materials and prices for same provided in the contract are: Furnishing and delivering 50,000 linear feet of Wakefield sheet piles, at 23 cents per linear foot; placing 3,130 Wakefield sheet piles in position, at 85 cents per pile; furnishing, delivering, and placing the following: 13,000 feet B. M. capping, including bolts and spikes, at \$35 per 1,000 feet B. M.; 2,333 square yards brush mattress, at 50 cents per square yard; 1,500 square yards brush protection or carpet, at 30 cents per square yard; 875 tons of random stone, in pieces weighing at least 500 pounds each, at \$3 per ton of 2,000 pounds; 2,525 tons of random stone, in pieces weighing less than 500 pounds each, at \$2.50 per ton of 2,000 pounds; 6,000 cubic yards of earth fill, at 30 cents per cubic yard; 1,000 cubic yards of gravel backing, at 20 cents per cubic yard; 1,190 cubic yards of loose brush, at 60 cents per cubic yard; 57 cubic yards of loose poles, at \$1 per cubic yard.

Respectfully submitted.

D. P. HEAP,  
*Colonel, Corps of Engineers.*

W. H. HEUER,  
*Lieutenant-Colonel, Corps of Engineers.*

R. P. JOHNSTON,  
*Captain, Corps of Engineers.*

Brig. Gen. G. L. GILLESPIE,  
*Chief of Engineers, U. S. A.*



# INDEX.

[The references in roman are to part and those in arabic to page. The letter "S" indicates the supplement.]

## A.

- Academy Creek, Ga. (*see* Brunswick Harbor)..... i, 267; ii, 1164
- Acts of Fifty-seventh Congress, second session, affecting Corps of Engineers. iv, 2943
- Acushnet River, Mass.:
  - Harbor lines at New Bedford and Fairhaven..... i, 640, 820
  - Improvement of New Bedford Harbor..... i, 92, 794
- Agate Bay, Minn., improvement of harbor..... i, 465; ii, 1793
- Agawam, Mass., South End Bridge across Connecticut River to Springfield.. i, 652
- Ahnapee Harbor, Wis., improvement of..... i, 480; ii, 1847
- Alabama and Mississippi Railroad Company, bridge of..... i, 645
- Alabama River, Ala., improvement of..... i, 302; ii, 1228
- Alameda, Cal.:
  - Bridge across San Leandro Bay to Bay Farm Island..... i, 646
  - Improvement of Oakland Harbor..... i, 582; iii, 2186
- Alameda County, Cal., bridge of..... i, 646
- Albany, N. Y.:
  - Harbor lines in Hudson River..... i, 640, 901
  - Removal of wreck in Hudson River..... i, 139, 888
- Albemarle and Chesapeake Canal, N. C., waterway via..... i, 226; ii, 1084
- Albemarle Sound, N. C.:
  - Improvement of waterway to Norfolk, Va., via Currituck Sound.. i, 226; ii, 1084
  - Improvement of waterway to Norfolk, Va., via Pasquotank River. i, 226; ii, 1083
  - Removal of wreck in..... i, 228; ii, 1088
- Alert (canal boat), removal of wreck of..... i, 139, 887
- Alexandria, La.:
  - Bridge across Red River to Pineville (Alexandria and Pineville Bridge Co.)..... i, 644
  - Bridge across Red River to Pineville (Shreveport and Red River Valley Rwy. Co.)..... i, 643
- Alexandria and Pineville Bridge Company, bridge of..... i, 644
- Allegheny, Pa.:
  - See also* Pittsburg Harbor.
  - Bridge across Allegheny River to Pittsburg (Union Bridge)..... i, 651
  - Bridge across Ohio River to borough of McKees Rocks..... i, 644
- Allegheny River, Pa.:
  - Bridge at Brilliant Station, Pittsburg..... i, 649
  - Bridge near Franklin (Big Rock Bridge)..... i, 651
  - Bridge at Franklin (county bridge)..... i, 651
  - Bridge at Herr Island, Pittsburg..... i, 649
  - Bridge at Kennerdell..... i, 647
  - Bridge between Pittsburg and Allegheny (Union Bridge)..... i, 651
  - Construction of locks and dams..... i, 438; ii, 1680
  - Harbor lines at Pittsburg..... i, 640; ii, 1706, 1709
  - Improvement by open-channel work..... i, 439; ii, 1686
  - Improvement of Pittsburg Harbor..... i, 432; ii, 1667
  - Operating and care of Herr Island dam..... i, 439; ii, 1683
- Allouez Bay, Wis. (*see* Duluth Harbor)..... i, 466; ii, 1794
- Alloway Creek, N. J., improvement of..... i, 169, 988
- Alpena Harbor, Mich., improvement of..... i, 523; iii, 1985
- Altamaha River, Ga., improvement of..... i, 264; ii, 1158

- Alva, Fla., bridge across Caloosahatchee River at Ferry Crossing ..... I, 647
- Alviso Harbor, Cal., improvement of ..... I, 580; III, 2181
- Ambrose channel, New York Harbor, N. Y., improvement of, including dredge construction ..... I, 139, 909, 976
- Amite River, La., improvement of ..... I, 338; II, 1305
- Amy, Dora (steamer), removal of wreck of ..... I, 194, 1024
- Anacostia River, D. C.:  
     Improvement of ..... I, 200; II, 1040  
     Survey of United States land within flats of ..... I, 36
- Anclote River, Fla., improvement of ..... I, 287; II, 1202
- Andura (Nandua) Creek, Va., improvement of ..... I, 207; II, 1054
- Ann, Cape, Mass.:  
     Construction of harbor of refuge, with report relative to completion of project ..... I, 62, 740, 742  
     Improvement of Rockport Harbor ..... I, 64, 743
- Anoka, Minn., bridge across Mississippi River ..... I, 643
- Apalachicola Bay and River, Fla.:  
     Improvement of bay ..... I, 291; II, 1209  
     Improvement of river, including the Cut-off ..... I, 292; II, 1212  
     Removal of wreck at Apalachicola ..... I, 306; II, 1236
- Appleton, Wis.:  
     *See also* Fox River.  
     Bridge across Fox River ..... I, 646
- Appomattox River, Va., improvement of ..... I, 223; II, 1080
- Appoquinimink River, Del., improvement of ..... I, 175, 995
- Appropriations:  
     Fortifications ..... I, 10, 14, 17  
     Rivers and harbors ..... I, 35, 36
- Aqueduct Bridge, Washington, D. C., repair of ..... I, 652; IV, 2483
- Aqueduct, Washington, D. C. *See* Washington.
- Aquia Creek, Va., improvement of ..... I, 207; II, 1055
- Aransas Pass, Tex., improvement of ..... I, 359; II, 1345
- Aransas Pass Harbor Company (*see* Aransas Pass) ..... I, 359; II, 1345
- Arcata, Cal. (*see* Humboldt Harbor) ..... I, 591; III, 2199
- Arch rock, San Francisco Harbor, Cal., removal of ..... I, 582; III, 2184
- Arkansas River:  
     Bridge between Arkansas and Desha counties, Ark. .... I, 643  
     Bridge near Fort Gibson, Ind. T. .... I, 642  
     Gauging (*see* Mississippi River Commission) ..... I, 639; S. 7, 8, 62, 97  
     Improvement of ..... I, 376; II, 1407
- Armament. *See* Fortifications.
- Army War College, Washington, D. C., buildings for ..... I, 674; IV, 2931
- Arthur Kill, N. Y. and N. J.:  
     Improvement of ..... I, 147, 932  
     Recommendation for stone monuments to mark established harbor lines. .... I, 141  
     Removal of wrecks ..... I, 158, 159, 955, 956
- Arthur Lake, La. (*see* Mermentau River) ..... I, 340; II, 1308
- Ashpoo River, S. C., waterway via, with estimates of cost ..... I, 255; II, 1132
- Ashland, Ky.:  
     *See also* Ohio River.  
     Bridge across Ohio River to Ironton, Ohio ..... I, 644
- Ashland and Ironton Bridge Company, bridge of ..... I, 644
- Ashland Harbor, Wis., improvement of ..... I, 469; II, 1811
- Ashley River, S. C., removal of wreck ..... I, 257; II, 1140
- Ashtabula Harbor, Ohio, improvement of, including dredge construction ..... I, 553, 979; III, 2093
- Assawaman Bay, Del., waterway via ..... I, 180, 1002
- Assistants:  
     Civilian, to engineer officers ..... I, 23  
     On duty in Office of the Chief of Engineers ..... I, 676
- Astoria, Oreg. (*see* Columbia River below Tongue Point) ..... I, 614; III, 2270
- Atchafalaya Basin levee board of Louisiana, lock and dam in Bayou Lafourche ..... I, 641
- Atchafalaya River, La.:  
     Gauging (*see* Mississippi River Commission) ..... I, 639; S. 7, 8, 62, 97  
     Rectification of mouth by Mississippi River Commission ..... I, 639; S. 3, 40
- Atchison, Topeka and Santa Fe Railway Company, bridge of ..... I, 647

- Atlantic City, N. J., bridges across Beach Thoroughfare and Lakes Ditch. i, 647, 648  
 Atlantic City, Va., harbor lines in Norfolk Harbor at ..... i, 640; ii, 1089  
 Atlantic County, N. J.:  
   Bridges of, across Lakes Ditch and Beach Thoroughfare ..... i, 648  
   Bridge of, across Patcong Creek ..... i, 651  
 Atlantic (South) States, removal of water hyacinths from Florida waters,  
   including report on experiments made ..... i, 279; ii, 1184; iv, 2433  
 Attorney-General, reports by:  
   On modification of bridges impeding navigation of Ohio River ..... i, 37  
   On title to lands embraced within flats of Anacostia River, D. C. .... i, 36  
 Aux Becs Scies Lake, Mich. (*see* Frankfort Harbor) ..... i, 518; iii, 1975

## B.

- Babson, Harriet W. (schooner), removal of wreck of ..... i, 53, 727  
 Back Bay of Biloxi, Miss. (*see* Biloxi Harbor) ..... i, 319; ii, 1264  
 Back Cove, Portland, Me. (*see* Portland) ..... i, 51, 725  
 Back River, Md., bridge across ..... i, 649  
 Back River, Mass. *See* Weymouth River.  
 Badger, Horace H. (schooner), removal of wreck of ..... i, 556; iii, 2105  
 Bad River, Mich., improvement of ..... i, 525; iii, 1986  
 Bagaduce River, Me., improvement of ..... i, 42, 716  
 Ballard, Wash.:  
   Improvement of Puget Sound-Lake Washington waterway ..... i, 629; iii, 2332  
   Reexamination of Puget Sound-Lake Washington waterway, with plans  
     and estimates of cost ..... i, 630; iii, 2340  
 Baltimore Harbor, Md.:  
   Bridge at Spring Garden ..... i, 649  
   Defenses of, including report on damp-proofing ..... i, 9; iv, 2400  
   Harbor lines in Patapsco River at Sparrow Point ..... i, 640; ii, 1033  
   Improvement at Spring Garden ..... i, 197; ii, 1031  
   Improvement of channel to ..... i, 194; ii, 1027  
   Improvement of channel to Curtis Bay ..... i, 196; ii, 1031  
   Revised estimate of cost of increasing depth of channel to ..... i, 195; ii, 1032  
 Baltimore (steamer), removal of wreck of ..... i, 324; ii, 1272  
 Bangor Harbor, Me. (*see* Penobscot River) ..... i, 43, 717  
 Barge No. 3, removal of wreck of, in Buffalo Bayou, Tex. .... i, 360, 361; ii, 1347  
 Bar Harbor, Me.:  
   Construction of breakwater ..... i, 39, 714  
   Defenses of, including report on telephone booths and damp-proof-  
     ing ..... i, 17, 19, 23, 674, 675, 683; iv, 2934  
 Barracks, Washington, D. C. .... i, 461; ii, 1776  
 Barrén River, Ky., operating and care of lock and dam ..... i, 368, 370; ii, 1379  
 Bartholomew Bayou, La. and Ark., improvement of ..... i, 104, 820  
 Bass Rip, Mass., removal of wrecks ..... i, 5, 18, 669, 686; iv, 2906  
 Battalions of Engineers ..... i, 9, 14, 17  
 Batteries, gun and mortar ..... i, 140, 911  
 Battery, the, New York, N. Y., removal of shoal in North River, off Pier A. i, 652  
 Bayboro, N. C., bridge across Bay River ..... i, 646  
 Bay Farm Island, Oakland Harbor, Cal., bridge across San Leandro Bay... i, 159, 955  
 Bayonne, N. J., removal of wreck in Newark Bay ..... i, 142, 915  
 Bay Ridge channel, New York Harbor, N. Y., improvement of ..... i, 652  
 Bay River, N. C., bridge at Bayboro ..... i, 139, 909  
 Bayside channel, New York Harbor, N. Y., improvement of ..... i, 647, 648  
 Beach Thoroughfare, N. J., bridges at Atlantic City ..... i, 236; ii, 1102  
 Beaufort Harbor, N. C.:  
   Improvement of ..... i, 235; ii, 1101  
   Improvement of waterway to Newbern ..... i, 236; ii, 1103  
   Improvement of waterway to New River ..... i, 236; ii, 1103  
 Beaufort Harbor and River, S. C.:  
   Defenses of Port Royal Sound, including report on damp-proofing . i, 9; iv, 2409  
   Improvement of river ..... i, 256; ii, 1139  
   Improvement of waterway to Charleston, S. C. .... i, 255; ii, 1138  
   Improvement of waterway to Savannah (*see* Savannah Harbor) .. i, 257; ii, 1141  
   Removal of logs from waterway to Charleston, S. C. .... i, 257; ii, 1140  
 Beautiful Island, Caloosahatchee River, Fla., bridge at ..... i, 649  
 Beechridge, Ill., prevention of break in Mississippi River at ..... i, 392; ii, 1455

- Belle River, Mich., improvement of ..... i, 531; iii, 1998  
 Bellingham Bay, Wash. *See* New Whatcom Harbor.  
 Benton Harbor, Mich., improvement of St. Joseph Harbor ..... i, 501; iii, 1937  
 Benton Harbor Canal, Mich. (*see* St. Joseph Harbor) ..... i, 501; iii, 1937  
 Bergen Point, N. J., removal of wreck in Newark Bay opposite ..... i, 158, 954  
 Bergen Point reef, Newark Bay, N. J., removal of wreck on ..... i, 158, 954  
 Berrian Island, East River, N. Y., harbor lines ..... i, 640, 891  
 Beverly Harbor, Mass., improvement of ..... i, 68, 746  
 Big Assawaman Bay, Del., waterway via ..... i, 180, 1002  
 Big Barren River, Ky., operating and care of lock and dam ..... i, 461; ii, 1776  
 Big Hocking River, Ohio, ice harbor in Ohio River near ..... i, 423; ii, 1627  
 Big Rock Bridge Company, bridge of ..... i, 651  
 Big Sandy Railway Company, bridge of ..... i, 647  
 Big Sandy River, W. Va. and Ky.:  
     Bridge across Levisa Fork at Whitehouse, Ky. .... i, 647  
     Improvement of, including Tug and Levisa forks ..... i, 448; ii, 1742  
     Operating and care of lock and dam ..... i, 450; ii, 1747  
 Big Sarasota Bay, Fla., improvement of ..... i, 284; ii, 1197  
 Big Sioux River, S. Dak., ice harbor at Sioux City, Iowa ..... i, 406; ii, 1551  
 Big Stone Lake, Minn., survey of ..... i, 404; ii, 1549  
 Big Sunflower River, Miss., improvement of ..... i, 373; ii, 1396  
 Biloxi Harbor, Miss., improvement of ..... i, 319; ii, 1264  
 Bird, Harry E. (barge), removal of wreck of ..... i, 165, 971  
 Biscayne Bay, Fla., improvement of ..... i, 277; ii, 1182  
 Bismarck Harbor, N. Dak. (*see* Missouri River) ..... i, 405; ii, 1551  
 Black Lake, Mich., improvement of Holland Harbor ..... i, 506; iii, 1948  
 Black River, Ark. and Mo., improvement of ..... i, 384; ii, 1432  
 Black River, La., improvement of ..... i, 366; ii, 1373  
 Black River, Mich.:  
     Improvement at mouth ..... i, 527; iii, 1993  
     Improvement at Port Huron ..... i, 529; iii, 1996  
 Black River, N. C.:  
     Bridge at Still Bluff ..... i, 648  
     Improvement of ..... i, 233; ii, 1105  
 Black River, Ohio:  
     Bridge at Lorain ..... i, 645  
     Improvement of Lorain Harbor ..... i, 547; iii, 2066  
 Black River, Wash., bridge in King County ..... i, 645  
 Black Rock Harbor, Conn. (*see* Bridgeport Harbor) ..... i, 115, 846  
 Black Rock Harbor, N. Y.:  
     Improvement of Buffalo entrance to ..... i, 562; iii, 2143  
     Improvement of Lake Erie entrance to ..... i, 562; iii, 2142  
 Black Warrior River, Ala.:  
     Improvement above Tuscaloosa ..... i, 309; ii, 1244  
     Improvement below Tuscaloosa ..... i, 309; ii, 1245  
     Operating and care of locks and dams ..... i, 315; ii, 1253, 1256  
     Removal of wreck ..... i, 324; ii, 1272  
 Blaine, James G. (schooner), removal of wreck of ..... i, 103, 820  
 Block Island, R. I.:  
     Construction of harbor of refuge ..... i, 101, 815  
     Improvement of Great Salt Pond ..... i, 102, 817  
 Blood River, La. (*see* Tickfaw River) ..... i, 338; ii, 1303  
 Blossom rock, San Francisco Harbor, Cal., removal of ..... i, 582; iii, 2184  
 Boards (*see also* Commissions):  
     Of Engineers for Rivers and Harbors (*see also* Committee, etc.) ..... i, 36, 637  
     Of Ordnance and Fortification ..... i, 8, 9, 12, 16  
     On Fortifications or other Defenses (Endicott Board) ..... i, 8, 9  
     The Board of Engineers ..... i, 8, 679  
 Boat railway, Columbia River, Oreg. and Wash. .... i, 604; iii, 2221  
 Boats:  
     *See also* Dredge and Snag boats, and Wrecks.  
     Rules governing running of steamers on certain streams ..... i, 641  
 Bouef River, La. and Ark., improvement of ..... i, 368, 370; ii, 1379  
 Bogue Chitto, La.:  
     Bridge at Franklinton ..... i, 650  
     Improvement of ..... i, 336; ii, 1300

- Bogue Falia, La., improvement of ..... i, 337; ii, 1301  
 Bogue Sound, N. C., improvement of waterway via ..... i, 236; ii, 1103  
 Boom Island, Mississippi River, Minneapolis, Minn., bridge at ..... i, 650  
 Boothbay Harbor, Me., removal of wreck at Ram Island light-house ..... i, 53, 727  
 Borden, Thomas (schooner), removal of wreck of ..... i, 103, 819  
 Boston Harbor, Mass.:  
     Bridges across Fort Point channel at Congress street and Mount Wash-  
         ington avenue ..... i, 652  
     Defenses of, including report on damp-proofing ..... i, 9; iv, 2374  
     Improvement of ..... i, 77, 764  
     Wreck, removal of ..... i, 88, 785  
 Boulevards. *See* Roads.  
 Braddock Point light station, Lake Ontario, N. Y., removal of wreck. i, 575; iii, 2169  
 Brandywine Creek or River, Del.:  
     Bridge at Wilmington ..... i, 649, 650  
     Improvement of Wilmington Harbor ..... i, 174, 992  
 Branford Harbor, Conn., improvement of ..... i, 109, 839  
 Braxton County, W. Va., bridge of ..... i, 649  
 Brays Bayou, Tex., bridge across ..... i, 647, 648  
 Brazos River, Tex.:  
     Improvement between Richmond and Old Washington ..... i, 357; ii, 1343  
     Improvement between Velasco and Richmond ..... i, 354, 357; ii, 1339  
     Improvement of month ..... i, 358; ii, 1344  
 Brazos River Channel and Dock Company (*see* Brazos River) ..... i, 358; ii, 1344  
 Brazos Santiago Harbor, Tex., improvement of ..... i, 360; ii, 1346  
 Breton Bay, Md., improvement of, including report on project by the Board  
     of Engineers for Rivers and Harbors ..... i, 201; ii, 1044, 1045  
 Bridge Creek Landing, Va., wharf at ..... i, 660; iv, 2517  
 Bridgeport Harbor, Conn., improvement of ..... i, 115, 846  
 Bridges:  
     Alteration of, obstructing navigation ..... i, 650, 651  
     Aqueduct Bridge, Washington, D. C., repair of ..... i, 652; iv, 2483  
     Construction of, across navigable waters ..... i, 642  
     Highway bridge, Washington, D. C., to replace Long Bridge. i, 643, 653; iv, 2484  
     In military divisions and departments ..... i, 667; iv, 2478, 2899  
     Memorial Bridge, Washington, D. C. .... i, 653; iv, 2484  
     Ohio River, impeding navigation ..... i, 37  
     Rules governing opening of draws ..... i, 642  
     Sakonnet River, R. I., alteration of Stone Bridge ..... i, 94, 798  
     Yellowstone National Park, construction, etc., of, with report concern-  
         ing technical features ..... i, 666; iv, 2444, 2885  
 Briggs, Maud (schooner), removal of wreck of ..... i, 88, 785  
 Brilliant Station, Pittsburg, Pa., bridge across Allegheny River ..... i, 649  
 Bristol, Me., bridge of town of ..... i, 652  
 Broad Creek River, Del., improvement of ..... i, 192, 1022  
 Broad Sound, Boston Harbor, Mass., improvement of ..... i, 77, 764  
 Bronx River, N. Y.:  
     Improvement of ..... i, 126, 862  
     Removal of wrecks ..... i, 138, 139, 887  
 Brooklyn, N. Y. *See* New York Harbor.  
 Browns Creek, N. Y., improvement of ..... i, 133, 874  
 Brunswick Harbor, Ga., improvement of ..... i, 267; ii, 1164  
 Brunswick River, N. C. (*see* Cape Fear River) ..... i, 240; ii, 1109  
 Bucksport Harbor, Me., improvement of ..... i, 45, 719  
 Budd Inlet, Wash. (*see* Olympia Harbor) ..... i, 626; iii, 2330  
 Buffalo Bayou, Tex.:  
     Improvement of ..... i, 351; ii, 1334  
     Removal of wrecks ..... i, 360, 361; ii, 1347  
 Buffalo Fork, Snake River, Wyo., road to Fort Washakie ..... i, 675; iv, 2937  
 Buffalo Fork, White River, Ark., improvement of ..... i, 382  
 Buffalo Harbor, N. Y.:  
     Improvement of ..... i, 559; iii, 2126  
     Improvement of Buffalo entrance to Erie Basin and Black Rock Har-  
         bor ..... i, 562; iii, 2143  
     Improvement of channels in waters connecting Great Lakes .... i, 532; iii, 2001  
     Improvement of Lake Erie entrance to Erie Basin and Black Rock  
         Harbor ..... i, 562; iii, 2142

## Buildings:

Army War College.....	i, 674; iv, 2931
Engineer School of Application .....	i, 674, 675; iv, 2934
Government Printing Office, Washington, D. C.....	i, 673; iv, 2919
Public, District of Columbia .....	i, 658; iv, 2517
School of Submarine Defense, Fort Totten, N. Y .....	i, 13, 16
Bulkhead lines. <i>See</i> Harbor lines.	
Burlington County, N. J., bridge of.....	i, 647
Burlington County Traction Company, bridge across Rancocas River.....	i, 647
Burlington Harbor, Vt., improvement of.....	i, 69, 748
Burnite, Jas. K. (schooner), removal of wreck of.....	i, 194, 1025
Burnt Mills, Tenn., bridge across Obion River.....	i, 646
Buttermilk channel, New York Harbor, N. Y.:	
Improvement of .....	i, 143, 917
Removal of obstruction in.....	i, 145, 925
Byram River, N. Y. ( <i>see</i> Port Chester Harbor) .....	i, 123, 858

## C.

Cable galleries, tanks, etc .....	i, 13, 15, 17
Cache River, Ark., improvement of.....	i, 383; ii, 1431
Cache River, Ill., prevention of Mississippi River from breaking into. ....	i, 392; ii, 1455
Caddo (Fairy) Lake, Tex. and La. ( <i>see</i> Cypress Bayou) .....	i, 365; ii, 1372
Cairo, Ill., prevention of break in Mississippi River near.....	i, 392; ii, 1455
Calaveras River, Cal. ( <i>see</i> Stockton and Mormon channels) .....	i, 585; iii, 2193
Calcasieu Parish, La., bridge of.....	i, 647
Calcasieu River, La.:	
Bridge across .....	i, 648
Improvement of mouth and passes.....	i, 341; ii, 1309
California Débris Commission .....	i, 638; iii, 2367
California, department of, reconnaissances and explorations.....	i, 668; iv, 2899
Caloosahatchee River, Fla.:	
Bridge at Beautiful Island .....	i, 649
Bridge at Ferry Crossing, Alva .....	i, 647
Improvement of .....	i, 282, 283; ii, 1194
Calumet Harbor, Wis. ( <i>see</i> Fox River).....	i, 489; ii, 1866
Calumet Harbor and River, Ill. and Ind.:	
Bridge at Cummings, Ill .....	i, 643, 644
Improvement of harbor .....	i, 493; iii, 1896
Improvement of river .....	i, 494; iii, 1901
Cambridge Harbor, Md., improvement of .....	i, 186, 1009
Camden, Me., improvement of harbor at .....	i, 46, 720
Camden, N. J.:	
Defenses of Delaware River .....	i, 9
Improvement of Cooper Creek.....	i, 167, 986
Improvement of Delaware River at .....	i, 159, 957
Removal of wreck in Cooper Creek .....	i, 194, 1024
Canadian canal, St. Marys River, Ontario, commerce through..	i, 535; iii, 2010, 2015
Canals, etc. ( <i>see also</i> Waterways).....	i, 35, 36
Albemarle and Chesapeake Canal, N. C., waterway via .....	i, 226; ii, 1084
Allegheny River, Pa., locks and dams .....	i, 438, 439; ii, 1680, 1683
Ashepoo River to South Edisto River, S. C., with estimates of cost ( <i>see</i> Charleston-Beaufort waterway).....	i, 255; ii, 1132
Barren River, Ky., lock and dam .....	i, 461; ii, 1776
Bee Tree Shoals Canal, Ala. ....	i, 418; ii, 1594
Benton Harbor Canal, Mich. ( <i>see</i> St. Joseph Harbor) .....	i, 501; iii, 1937
Big Barren River, Ky., lock and dam .....	i, 461; ii, 1776
Big Sandy River, W. Va. and Ky., locks and dams.....	i, 448, 450; ii, 1742, 1747
Big Stone Lake, Minn., reservoir dam .....	i, 404; ii, 1549
Black River, La., locks and dams.....	i, 366; ii, 1373
Black Warrior River, Ala., locks and dams.....	i, 309, 315; ii, 1244, 1253, 1256
Calaveras River, Cal., to Mormon channel, San Joaquin River ..	i, 585; iii, 2193
Canadian canal, St. Marys River, Ontario, commerce.....	i, 535; iii, 2010, 2015
Cape Fear River above Wilmington, N. C., locks and dams .....	i, 239; ii, 1105
Cascades Canal, Columbia River, Oreg .....	i, 606, 608; iii, 2222, 2224
Chicago Drainage Canal, Ill.....	i, 640
Clubfoot and Harlowe Canal, N. C., waterway via .....	i, 235; ii, 1101

## Canals, etc.—Continued.

- Colbert Shoals Canal, Ala. .... i, 418; ii, 1594  
Columbia River, Cascades Canal. .... i, 606, 608; iii, 2222, 2224  
Columbia River, The Dalles Rapids to Celilo Falls, locks and  
dams ..... i, 604; iii, 2221  
Congaree River, S. C., lock and dam ..... i, 251; ii, 1130  
Coosa River, Ga. and Ala., locks and dams ..... i, 303, 306; ii, 1230, 1235  
Courtableau Bayou, La., lock and dam ..... i, 334; ii, 1295  
Cumberland River, Tenn. and Ky., locks and dams .... i, 412, 414; ii, 1581, 1585  
Davis Island dam, Ohio River, Pa. .... i, 435; ii, 1671  
Des Moines Rapids Canal, Mississippi River, with report on enlarge-  
ment of locks and for dam at foot of rapids ..... i, 395; ii, 1491, 1500  
Dismal Swamp Canal, Va. and N. C., waterway via ..... i, 225; ii, 1083  
Duluth Canal, Minn., improvement of ..... i, 466; ii, 1794  
Edisto (South) River to Ashepoo River, S. C., with estimates of cost  
(see Charleston-Beaufort waterway) ..... i, 255; ii, 1132  
Estherville-Minim Creek Canal, S. C. (see Santee River) ..... i, 248; ii, 1127  
Expenditures for operating and care ..... i, 36  
Fox River, Wis., locks and dams ..... i, 489, 491; ii, 1866, 1870  
Galena River, Ill., lock and dam ..... i, 395; ii, 1498  
Galveston and Brazos Canal, Tex., purchase of ..... i, 355; ii, 1339  
Gowanus Canal, New York Harbor, N. Y. (see Gowanus Bay) ..... i, 142, 915  
Grand Rapids, Wabash River, lock and dam ..... i, 457, 459; ii, 1772, 1773  
Great Kanawha River, W. Va., locks and dams ..... i, 444, 445; ii, 1721, 1723  
Green River, Ky., locks and dams ..... i, 461; ii, 1775, 1776  
Herr Island, Allegheny River, Pa., lock and dam ..... i, 438, 439; ii, 1680, 1683  
Illinois and Mississippi Canal, Ill., construction of ..... i, 496; iii, 1920  
Illinois and Mississippi Canal, Ill., operating and care ..... i, 396; ii, 1496  
Illinois River, Ill., locks and dams ..... i, 495, 496; iii, 1915, 1917  
Illinois River, Ill., survey for waterway via ... i, 494, 639; iii, 1904; S. 7, 68, 167  
Kampsville lock and dam, Illinois River, Ill. .... i, 496; iii, 1917  
Kanawha River, W. Va., locks and dams ..... i, 444, 445; ii, 1721, 1723  
Kentucky River, Ky., locks and dams ..... i, 450, 451; ii, 1748, 1753  
Keweenaw Bay to Lake Superior, improvement and care ... i, 471, 472; ii, 1815  
Keweenaw Bay to Lake Superior, wreck ..... i, 475; ii, 1827  
Lafourche Bayou, La., lock and dam ..... i, 641  
Lagrange lock and dam, Illinois River, Ill. .... i, 496; iii, 1917  
Lake Washington Canal, Wash. See Puget Sound.  
Levisa Fork, Big Sandy River, Ky., locks and dams ..... i, 448; ii, 1742  
Little Kanawha River, W. Va., lock and dam ..... i, 443, 444; ii, 1718, 1719  
Lockport, Ill., to St. Louis, Mo., survey for waterway  
..... i, 494, 639; iii, 1904; S. 7, 68, 167  
Louisville and Portland Canal, improvement and care ... i, 452, 455; ii, 1763, 1765  
Mermentau River, La., lock and dam ..... i, 641  
Michigan Lake to Sturgeon Bay, improvement and care ... i, 478, 480; ii, 1841, 1846  
Michigan Lake Superior Power Co.'s canal ..... i, 641  
Minim Creek-Estherville Canal, S. C. (see Santee River) ..... i, 248; ii, 1127  
Mississippi River, Des Moines Rapids Canal, with report on enlarge-  
ment of locks and for dam at foot of rapids ..... i, 395; ii, 1491, 1500  
Mississippi River to Illinois River, construction of ..... i, 496; iii, 1920  
Mississippi River to Illinois River, operating and care ..... i, 395; ii, 1496  
Mississippi River, reservoirs, construction of ..... i, 396; ii, 1528  
Mississippi River, reservoirs, operating and care ..... i, 399; ii, 1538  
Mississippi River, St. Paul to Minneapolis, locks and dams ... i, 396; ii, 1523  
Monongahela River, locks and dams ..... i, 427, 429, 431; ii, 1652, 1658, 1660  
Morgan Canal, Tex., improvement of (see Galveston ship chan-  
nel) ..... i, 351; ii, 1334  
Morgan Canal, Tex., operating and care ..... i, 353; ii, 1337  
Mormon channel, San Joaquin River, Cal., to Calaveras River .. i, 585; iii, 2193  
Mosquito Creek Canal, S. C. (see Santee River) ..... i, 248; ii, 1127  
Muscle Shoals Canal, Ala. .... i, 417, 419; ii, 1594, 1605  
Muskingum River, Ohio, locks and dams ..... i, 446, 447; ii, 1731, 1732  
Navigation of, rules governing ..... i, 641  
North Carolina Cut, N. C., improvement of waterway via ..... i, 226; ii, 1084  
Ohio River, Lock and Dam 1, at Davis Island, Pa ..... i, 435; ii, 1671  
Ohio River, Locks and Dams 2-7 ..... i, 435; ii, 1672  
Ohio River, Locks and Dams 8, 11, 13, 18, 19 ..... i, 441; ii, 1713  
Ohio River, Lock and Dam 37 ..... i, 426; ii, 1645

## Canals, etc.—Continued.

- Ohio River, Louisville and Portland Canal, improvement and care ..... i, 452, 455; ii, 1763, 1765
- Ossage River, Mo., lock and dam ..... i, 408; ii, 1568
- Otter Tail Lake and River, Minn., reservoir dam ..... i, 404; ii, 1548
- Ouachita River, Ark. and La., locks and dams ..... i, 366; ii, 1373
- Plaquemine Bayou, La., lock ..... i, 332; ii, 1289
- Portage Lake canals, Mich., improvement and care ..... i, 471, 472; ii, 1815
- Portage Lake canals, Mich., wreck ..... i, 475; ii, 1827
- Port Arthur Canal, Tex., connection with Sabine Lake ..... i, 344; ii, 1314
- Puget Sound to Lake Washington, bridge at Seattle, Wash. .... i, 645
- Puget Sound to Lake Washington, improvement ..... i, 629; iii, 2332
- Puget Sound to Lake Washington, reexamination ..... i, 630; iii, 2340
- Red Lake and Red Lake River, Minn., reservoir dam ..... i, 403; ii, 1548
- Regulations governing navigation of ..... i, 641
- Rock River, Ill., construction of canal around ..... i, 496; iii, 1920
- Rock River, Ill., operating and care of canal around ..... i, 395; ii, 1496
- Rough River, Ky., lock and dam ..... i, 463, 464; ii, 1788, 1789
- Rules governing navigation of ..... i, 641
- St. Clair Flats Canal, Mich., improvement and care ... i, 539, 540; iii, 2033, 2034
- St. Louis, Mo., to Lockport, Ill., survey for waterway ..... i, 494, 639 iii, 1904; S., 7, 68, 167
- St. Marys Falls Canal, Mich., improvement and care.. i, 534, 535; iii, 2006, 2010
- St. Marys Falls canals, Mich. and Ontario, commerce .... i, 535; iii, 2010, 2015
- St. Marys River, Mich., water-power canal at Sault Ste. Marie ..... i, 641
- Salmon Bay, Wash., improvement of waterway via ..... i, 629; iii, 2332
- Salmon Bay, Wash., reexamination of waterway via ..... i, 630; iii, 2340
- Sanitary District of Chicago, Ill., canal of ..... i, 640
- Seattle Canal, Wash., bridge at Seattle ..... i, 645
- Seattle Canal, Wash., improvement of ..... i, 629; iii, 2332
- Seattle Canal, Wash., reexamination of ..... i, 630; iii, 2340
- Shilshole Bay, Wash., improvement of waterway via ..... i, 629; iii, 2332
- Shilshole Bay, Wash., reexamination of waterway via ..... i, 630; iii, 2340
- Six-mile Island, Allegheny River, Pa., lock and dam ..... i, 438; ii, 1680
- South Edisto River to Ashepoo River, S. C., with estimates of cost (*see* Charleston-Beaufort waterway) ..... i, 255; ii, 1132
- Springdale, Pa., lock and dam in Allegheny River ..... i, 438; ii, 1680
- Sturgeon Bay and Lake Michigan Canal, improvement and care ..... i, 478, 480; ii, 1841, 1846
- Superior Lake to Keweenaw Bay, improvement and care... i, 471, 472; ii, 1815
- Superior Lake to Keweenaw Bay, wreck ..... i, 475; ii, 1827
- Tennessee River, canals, locks, and dams ..... i, 417, 419; ii, 1591, 1594, 1605
- Tombigbee River, Ala., locks and dams ..... i, 310, 312; ii, 1246, 1248
- Traverse Lake, Minn., reservoir dam ..... i, 404; ii, 1549
- Trinity River, Tex., locks and dams ..... i, 354; ii, 1338
- Tug Fork, Big Sandy River, W. Va. and Ky., locks and dams... i, 448; ii, 1742
- Turners Cut, N. C., waterway via ..... i, 225; ii, 1083
- Union Lake, Wash., improvement of waterway via ..... i, 629; iii, 2332
- Union Lake, Wash., reexamination of waterway via ..... i, 630; iii, 2340
- Wabash River, Grand Rapids lock and dam ..... i, 457, 459; ii, 1772, 1773
- Warrior River, Ala., locks and dams ..... i, 309, 315; ii, 1244, 1253, 1256
- Washington Lake to Puget Sound, bridge at Seattle, Wash. .... i, 645
- Washington Lake to Puget Sound, improvement of waterway... i, 629; iii, 2332
- Washington Lake to Puget Sound, reexamination of waterway.. i, 630; iii, 2340
- Washita (Ouachita) River, Ark. and La., locks and dams ..... i, 366; ii, 1373
- White River, Ark., locks and dams ..... i, 381; ii, 1420
- Yamhill River, Oreg., lock and dam ..... i, 609, 612; iii, 2257, 2261
- Canarsie Bay, N. Y., improvement of ..... i, 130, 869
- Cape Ann, Mass.:
- Construction of harbor of refuge in Sandy Bay, with report relative to completion of project ..... i, 62, 740, 742
- Improvement of Rockport Harbor ..... i, 64, 743
- Cape Charles City Harbor, Va., improvement of ..... i, 224; ii, 1081
- Cape Fear River, N. C.:
- Defenses of, including report on damp-proofing and on use of paint made of coal tar and kerosene oil ..... i, 9; iv, 2408
- Improvement above Wilmington ..... i, 239; ii, 1105



## Cape Fear River, N. C.—Continued.

- Improvement at and below Wilmington ..... i, 240; ii, 1109
- Improvement of Northeast Branch ..... i, 238; ii, 1105
- Cape Henry, Va., defenses at ..... i, 9
- Cape Poge light-house, Mass., removal of wreck ..... i, 103, 819
- Cape Vincent Harbor, N. Y., improvement of ..... i, 572; iii, 2162
- Capitol, Washington, D. C., telegraph line ..... i, 659; iv, 2517
- Carleton, P. J. (barge), removal of wreck of ..... i, 145, 924
- Carlows Island, Me., bridge to Point Pleasant ..... i, 652
- Carquines Straits, Cal., channel to the Golden Gate (*see* San Pablo Bay) ..... i, 583; iii, 2189
- Carrabelle bar and harbor, Fla., improvement of ..... i, 290; ii, 1207
- Carrabelle, Tallahassee and Georgia Railroad Company, bridges of ..... i, 652
- Carriages, gun and mortar ..... i, 10
- Carters Creek, Va.:
  - Improvement of ..... i, 208; ii, 1056
  - Removal of wreck ..... i, 218; ii, 1071
- Caruthersville Harbor, Mo. (*see* Mississippi River Commission) ..... i, 639; S., 3, 40
- Carvers Harbor, Me., improvement of ..... i, 48, 722
- Cascades Canal, Columbia River, Oreg.:
  - Construction of ..... i, 606; iii, 2222
  - Operating and care ..... i, 608; iii, 2224
- Casemates, mining ..... i, 13, 15, 17
- Castlerock, Wash., bridge across Cowlitz River ..... i, 648
- Catahoula Parish, La., bridge of ..... i, 646
- Cedar Bayou, Tex., improvement of ..... i, 354, 356; ii, 1339
- Centennial Lake, Miss. (*see* Vicksburg Harbor) ..... i, 370; ii, 1385
- Central of Georgia Railway Company, bridge of ..... i, 652
- Central Vermont Railway Company, bridge of ..... i, 652
- Champlain Lake, N. Y. and Vt.:
  - Burlington Harbor, Vt., improvement of ..... i, 69, 748
  - Defenses of ..... i, 9
  - Narrows, improvement of ..... i, 72, 752
  - North and South Hero islands, improvement of channel between ..... i, 69
  - Plattsburg Harbor, N. Y., improvement of ..... i, 72, 751
  - Wrecks between Whitehall, N. Y., and Larabee Landing, Vt., removal of ..... i, 73, 753
- Channels. *See* Rivers and harbors.
- Charles River, Mass. (*see* Boston Harbor) ..... i, 78, 766
- Charleston Harbor, S. C.:
  - Defenses of, including report on damp-proofing ..... i, 9; iv, 2409
  - Improvement of, including dredge construction ..... i, 253, 972; ii, 1134
  - Improvement of waterway to Beaufort, S. C. .... i, 255; ii, 1138
  - Improvement of waterway to McClellanville, with estimates of cost. i, 252; ii, 1132
  - Removal of logs from waterway to Beaufort, S. C. .... i, 257; ii, 1140
- Charlevoix Harbor, Mich., improvement of ..... i, 519; iii, 1978
- Charlotte Harbor, Fla., improvement of ..... i, 282; ii, 1194
- Charlotte Harbor, N. Y.:
  - Improvement of ..... i, 567; iii, 2153
  - Water levels ..... i, 665; iv, 2678
- Charts:
  - Land within flats of Anacostia River, D. C. .... i, 36
  - Military and other ..... i, 667, 673; iv, 2478, 2899
  - Northern and Northwestern Lakes ..... i, 660, 665; iv, 2671
- Chatham Harbor, Mass.:
  - Improvement of ..... i, 88, 785
  - Removal of wreck off Hardings Beach light ..... i, 103, 820
- Chattahoochee River, Ga. and Ala., improvement of ..... i, 296; ii, 1218
- Cheboygan Harbor, Mich., improvement of ..... i, 522; iii, 1983
- Cheesequake Creek, N. J., bridge across ..... i, 650
- Chefuncte River, La., improvement of ..... i, 337; ii, 1301
- Chehalis River, Wash., improvement of ..... i, 623; iii, 2327
- Chelesa Creek, Mass. (*see* Boston Harbor) ..... i, 80, 767
- Chemicals, use of, in destroying the water hyacinth ..... i, 279, 343; ii, 1184, 1312; iv, 2433
- Chequamegon Bay, Wis. (*see* Ashland Harbor) ..... i, 469; ii, 1811
- Chesapeake and Ohio Railway Company, bridge of, across Levisa Fork, Big Sandy River, Ky. .... i, 647

- Chesapeake Bay, Md. and Va.:  
 Defenses at entrance at Cape Henry, Va. .... i, 9  
 Improvement of Cape Charles City Harbor, Va. .... i, 224; ii, 1081  
 Chester River, Md., improvement of ..... i, 187, 1010  
 Chicago, Burlington and Quincy Railroad Company, bridge of ..... i, 648  
 Chicago Drainage Canal, Ill., connection of Chicago River with ..... i, 640  
 Chicago Harbor and River, Ill.:  
 Bridge across Little Calumet River ..... i, 647  
 Bridge across North Branch at Western avenue ..... i, 646  
 Bridge across South Branch at Randolph street ..... i, 646  
 Bridges across South Branch at Eighteenth street and at Loomis street ..... i, 649  
 Bridge across South Fork of South Branch at Archer avenue ..... i, 647  
 Bridge at State street ..... i, 646  
 Drainage canal, connection with river ..... i, 640  
 Improvement of Calumet (South Chicago) Harbor ..... i, 493; iii, 1896  
 Improvement of channels in waters connecting Great Lakes ..... i, 532; iii, 2001  
 Improvement of outer harbor ..... i, 491; iii, 1887  
 Improvement of river ..... i, 492; iii, 1892  
 Chicago, Milwaukee and St. Paul Railway Company, bridge of ..... i, 649  
 Chickasahay River, Miss.:  
 Bridge at Leakesville ..... i, 645  
 Improvement of ..... i, 318; ii, 1260  
 Chief of Engineers, officers on duty in Office of the ..... i, 676  
 Chillicothe, Ill., bridge across Illinois River ..... i, 647  
 China Basin, San Francisco Harbor, Cal., harbor lines north of ..... i, 640; iii, 2202  
 Chincoteague Bay, Va., improvement of waterway to Delaware Bay ..... i, 180, 1002  
 Chincoteague light-house, Va., removal of wreck ..... i, 194, 1024  
 Chinook River, Wash., bridge across ..... i, 647  
 Chipola River, Fla.:  
 Improvement of lower river ..... i, 292; ii, 1212  
 Improvement of upper river ..... i, 294; ii, 1213  
 Chitto, Bogue, La.:  
 Bridge at Franklinton ..... i, 650  
 Improvement of ..... i, 336; ii, 1300  
 Choctawhatchee River, Fla. and Ala., improvement of ..... i, 298; ii, 1220  
 Choptank River, Md.:  
 Improvement of ..... i, 187, 1012  
 Improvement of Cambridge Harbor ..... i, 186, 1009  
 Christiana River, Del., improvement of Wilmington Harbor ..... i, 174, 992  
 Cincinnati, Ohio:  
 Construction of Lock and Dam 37, Ohio River, below ..... i, 428; ii, 1645  
 General improvement of Ohio River ..... i, 423; ii, 1627  
 City of Austin (vessel), removal of wreck of ..... i, 271; ii, 1171  
 Civilian assistants to engineer officers ..... i, 23  
 Claiborne Harbor, Md., improvement of ..... i, 185, 1008  
 Clark Fork, Columbia River, Wash. (*see* Pend Oreille River) ..... i, 635; iii, 2338  
 Clatskanie River, Oreg., improvement of ..... i, 616; iii, 2318  
 Clatsop County, Oreg., bridge of ..... i, 649  
 Cleveland Harbor, Ohio:  
 Bridges of Newburgh and South Shore Railway Company ..... i, 650  
 Bridges, municipal, at Jefferson street ..... i, 647  
 Improvement of, including dredge construction ..... i, 649, 979; iii, 2071  
 Removal of wrecks ..... i, 556; iii, 2105  
 Water levels ..... i, 665; iv, 2678  
 Clinch River, Tenn.:  
 Bridge at Dossett ..... i, 644  
 Improvement of ..... i, 421; ii, 1619  
 Clinton River, Mich., improvement of ..... i, 531; iii, 1998  
 Clubfoot and Harlowe Canal, N. C., waterway via ..... i, 235; ii, 1101  
 Clubfoot Creek, N. C., waterway via ..... i, 235; ii, 1101  
 Coanock Bay, N. C., waterway via ..... i, 226; ii, 1084  
 Coast defenses. *See* Fortifications.  
 Cocheo River, N. H., improvement of ..... i, 56, 734  
 Coeymans (North), N. Y., removal of wreck in Hudson River ..... i, 139, 888  
 Cogswell, Jas. (barge), removal of wreck of ..... i, 139, 888  
 Cohansey Creek, N. J., removal of wreck ..... i, 194, 1024  
 Cohasset Harbor, Mass., improvement of, including report on project by the  
 Board of Engineers for Rivers and Harbors ..... i, 83, 773, 774

- Collar, B. L. (barge), removal of wreck of ..... i, 138, 887  
 College, War, Army, Washington, D. C., buildings for..... i, 674; iv, 2931  
 Colleton County, S. C., bridge of..... i, 645  
 Colorado, department of the, reconnaissances and explorations.. i, 668, 672; iv, 2916  
 Columbia, department of the, reconnaissances and explorations.. i, 668, 672; iv, 2916  
 Columbia River, Oreg. and Wash.:  
     Cascades Canal, construction of..... i, 606; iii, 2222  
     Cascades Canal, operating and care..... i, 608; iii, 2224  
     Celilo, Oreg., improvement above..... i, 602; iii, 2218  
     Celilo Falls to The Dalles Rapids, boat railway..... i, 604; iii, 2221  
     Celilo Falls to The Dalles Rapids, locks and dams..... i, 604; iii, 2221  
     Clark Fork (*see* Pend Oreille River)..... i, 635; iii, 2338  
     Gauging..... i, 619; iii, 2321  
     Mouth of, defenses at, including report on construction methods and on speaking tubes..... i, 9; iv, 2423  
     Mouth of, improvement at, including dredge construction and report on project..... i, 614, 975; iii, 2271, 2275  
     Mouth of, to Willamette River, improvement from..... i, 612; iii, 2263  
     Three-mile Rapids, improvement at..... i, 604; iii, 2221  
     Tongue Point, Oreg., improvement below..... i, 614; iii, 2270  
     Vancouver, Wash., to Willamette River, improvement from.... i, 608; iii, 2228  
 Commencement Bay, Wash., improvement of Tacoma Harbor..... i, 627; iii, 2331  
 Commercial statistics, Sault Ste. Marie canals, Mich..... i, 535; iii, 2010, 2015  
 Commissions (*see also* Boards):  
     California Débris Commission..... i, 638; iii, 2367  
     Mississippi River Commission..... i, 639; S. 3, 40  
     Permanent International Commission of Congresses of Navigation..... i, 639  
 Committee on Rivers and Harbors, House of Representatives, reports submitted by Board of Engineers for Rivers and Harbors, in pursuance of resolution of..... i, 637  
     Breton Bay, Md..... i, 202; ii, 1045  
     Cohasset Harbor, Mass..... i, 83, 774  
     Oconto Harbor, Wis..... i, 476; ii, 1836  
     Patuxent River, Md..... i, 203; ii, 1048  
     Scituate Harbor, Mass..... i, 84, 777  
 Compton Creek, N. J., improvement of..... i, 154, 948  
 Comstock, John. (schooner), removal of wreck of..... i, 145, 924  
 Conecuh River, Ala., improvement of..... i, 301; ii, 1226  
 Congaree River, S. C.:  
     Construction of lock and dam near Granby..... i, 251; ii, 1130  
     Improvement by open-channel work..... i, 250; ii, 1129  
 Congresses of Navigation, Permanent International Commission of..... i, 639  
 Conneaut Harbor, Ohio, improvement of, including dredge construction..... i, 555, 979; iii, 2099  
 Connecticut River, Mass. and Conn.:  
     Bridge at Hartford, Conn..... i, 644  
     Bridge between Springfield and Agawam, Mass. (South End Bridge)..... i, 652  
     Improvement below Hartford, Conn..... i, 107, 836  
 Connecticut River Bridge and Highway District, bridge of..... i, 644  
 Contentnia Creek, N. C., improvement of..... i, 232; ii, 1096  
 Contingencies of rivers and harbors, estimate of appropriation for..... i, 636  
 Continuing contracts..... i, 36  
     Albemarle Sound, N. C., waterway via..... i, 225; ii, 1083  
     Allegheny River, Pa., locks and dams..... i, 438; ii, 1680  
     Ambrose channel, New York Harbor, N. Y..... i, 139, 909, 979  
     Appomattox River, Va..... i, 223; ii, 1080  
     Arthur Kill, N. Y. and N. J..... i, 147, 932  
     Ashtabula Harbor, Ohio..... i, 553, 979; iii, 2093  
     Back Cove, Portland, Me..... i, 51, 725  
     Baltimore Harbor, Md., channel to Curtis Bay..... i, 196; ii, 1031  
     Baltimore Harbor, Md., Patapsco River and channel to..... i, 194; ii, 1027  
     Baltimore Harbor, Md., at Spring Garden..... i, 197; ii, 1031  
     Bay Ridge channel, New York Harbor, N. Y..... i, 142, 915  
     Bee Tree shoals, Tennessee River, Ala..... i, 418; ii, 1591, 1594  
     Big Sandy River, W. Va. and Ky., including the forks..... i, 448; ii, 1742  
     Biscayne Bay, Fla..... i, 277; ii, 1182  
     Black River, La..... i, 366; ii, 1373

## Continuing contracts—Continued.

Black River (Lorain) Harbor, Ohio.....	i, 547; iii, 2066
Black Rock Harbor, Buffalo, N. Y., Lake Erie entrance.....	i, 562; iii, 2142
Black Warrior River, Ala., above Tuscaloosa.....	i, 309; ii, 1244
Black Warrior River, Ala., below Tuscaloosa.....	i, 309; ii, 1245
Boston Harbor, Mass.....	i, 77, 764
Bridgeport Harbor, Conn.....	i, 115, 846
Buffalo Bayou, Tex.....	i, 351; ii, 1334
Buffalo Harbor, N. Y.....	i, 559; iii, 2126
Buffalo Harbor, N. Y., lake Erie entrance to Erie Basin and Black Rock Harbor.....	i, 562; iii, 2142
Calumet Harbor, Ill.....	i, 493; iii, 1896
Charleston Harbor, S. C.....	i, 253, 972; ii, 1134
Christiana River, Del.....	i, 174, 992
Cleveland Harbor, Ohio.....	i, 549, 979; iii, 2071
Colbert shoals, Tennessee River, Ala.....	i, 418; ii, 1591, 1594
Columbia River, Oreg. and Wash., at the mouth.....	i, 614, 975; iii, 2271, 2275
Columbia River, Oreg. and Wash., The Dalles Rapids to Celilo Falls.....	i, 604; iii, 2221
Congaree River, S. C., between Columbia and Granby.....	i, 251; ii, 1130
Conneaut Harbor, Ohio.....	i, 555, 979; iii, 2099
Croatan Sound, N. C., waterway via.....	i, 225; ii, 1083
Cumberland Sound, Ga. and Fla.....	i, 270, 974; ii, 1168
Curtis Bay, Baltimore, Md., channel to.....	i, 196; ii, 1031
Deep Creek, Va.....	i, 225; ii, 1083
Delaware Bay, Del., harbor of refuge.....	i, 164, 970
Delaware River, N. J., Pa., and Del.....	i, 159, 957
Detroit River, Mich.....	i, 540; iii, 2036
Dog River, Miss.....	i, 315; ii, 1258
Duluth Harbor, Minn.....	i, 466; ii, 1794
East (Ambrose) channel, New York Harbor, N. Y.....	i, 139, 909, 979
Elizabeth River, Va., Hospital Point, Norfolk.....	i, 220; ii, 1074
Elizabeth River, Va., waterway to sounds of North Carolina.....	i, 225; ii, 1083
Erie Basin, Buffalo, N. Y., Lake Erie entrance.....	i, 562; iii, 2142
Everett Harbor, Wash.....	i, 631; iii, 2334
Fall River Harbor, Mass.....	i, 97, 803
Falls of Ohio River at Louisville, Ky.....	i, 452; ii, 1763
Galveston Harbor, Tex.....	i, 348; ii, 1321
Galveston Harbor, Tex., inner bar to Fifty-first street.....	i, 350; ii, 1328
Galveston-Houston waterway, Tex.....	i, 351; ii, 1334
Gloucester Harbor, Mass.....	i, 65, 744
Gowanus Bay channels, New York Harbor, N. Y.....	i, 142, 915
Grays Harbor and bar entrance, Wash.....	i, 621; iii, 2325
Great Lakes, channels in connecting waters of.....	i, 532; iii, 2001
Great Pedee River, S. C.....	i, 245; ii, 1120
Gulfport, Miss., channel to Ship Island Harbor.....	i, 320; ii, 1266
Hampton Roads, Va.....	i, 221; ii, 1076
Harbor Beach, Mich.....	i, 526; iii, 1989
Hay Lake channel, St. Marys River, Mich.....	i, 537; iii, 2027
Horn Island Harbor, Miss.....	i, 315; ii, 1258
Hospital Point, Norfolk Harbor, Va.....	i, 220; ii, 1074
Houston-Galveston waterway, Tex.....	i, 351; ii, 1334
Hudson River, N. Y.....	i, 135, 877
Illinois and Mississippi Canal, Ill.....	i, 496; iii, 1920
Indiana Chute, Falls of Ohio River, Louisville, Ky.....	i, 452; ii, 1763
Kalamazoo River, Mich.....	i, 504; iii, 1945
Kennebec River, Me.....	i, 50, 724
Kentucky River, Ky.....	i, 450; ii, 1748
Keweenaw Bay to Lake Superior, Mich., waterway.....	i, 471; ii, 1815
Levisa Fork, Big Sandy River, Ky.....	i, 448; ii, 1742
Lorain Harbor, Ohio.....	i, 547; iii, 2066
Louisville and Portland Canal, Ky.....	i, 452; ii, 1763
Loutre, Pass a, Mississippi River, sill across.....	i, 325; ii, 1276
Ludington Harbor, Mich.....	i, 514; iii, 1966
Marquette Harbor, Mich.....	i, 473; ii, 1820
Maumee Bay and River, Ohio (see Toledo Harbor).....	i, 542, 979; iii, 2049
Michigan City outer harbor, Ind.....	i, 498, 499; iii, 1931

## Continuing contracts—Continued.

Michigan Lake-Sturgeon Bay Canal, including harbor of refuge..	i, 478; ii, 1841
Mississippi River, Head of Passes to Ohio River.....	i, 639; S., 3, 40
Mississippi River, between Missouri and Ohio rivers.....	i, 390; ii, 1445
Mississippi River, between Missouri River and St. Paul.....	i, 393; ii, 1468
Mississippi River, sill across Pass a Loutre.....	i, 325; ii, 1276
Mississippi River, between St. Paul and Minneapolis.....	i, 396; ii, 1523
Mississippi River, Southwest Pass.....	i, 326, 980; ii, 1277
Mississippi River, Vicksburg Harbor, Miss.....	i, 370; ii, 1385
Mobile Harbor, Ala.....	i, 307; ii, 1237
Monongahela River, W. Va. and Pa.....	i, 427, 429; ii, 1652, 1658
Mormon channel, San Joaquin River, Cal.....	i, 585; iii, 2193
Narragansett Bay, R. I.....	i, 95, 801
Neebish channels, St. Marys River, Mich.....	i, 537; iii, 2027
New Haven Harbor, Conn.....	i, 110, 839
New London Harbor, Conn.....	i, 105, 833
New York Harbor, N. Y., Ambrose channel.....	i, 139, 909, 979
New York Harbor, N. Y., Gowanus Bay channels.....	i, 142, 915
Norfolk Harbor, Va., Hospital Point.....	i, 220; ii, 1074
Norfolk Harbor, Va., waterway to sounds of North Carolina.....	i, 225; ii, 1083
Northern and Northwestern Lakes, channels connecting.....	i, 532; iii, 2001
Oakland Harbor, Cal.....	i, 582; iii, 2186
Ocmulgee River, Ga.....	i, 266; ii, 1161
Ohio River, Dams Nos. 2-5.....	i, 435; ii, 1672
Ohio River, Dams Nos. 8, 11, 13, and 18.....	i, 441; ii, 1713
Ohio River, Dam No. 37.....	i, 426; ii, 1645
Ohio River, Falls of, at Louisville, Ky.....	i, 452; ii, 1763
Ouachita River, Ark. and La.....	i, 366; ii, 1373
Pamlico Sound, N. C., waterway to Norfolk Harbor, Va.....	i, 225; ii, 1083
Pascagoula River, Miss., below mouth of Dog River.....	i, 315; ii, 1258
Pasquotank River, N. C., waterway via.....	i, 225; ii, 1083
Passaic River, N. J.....	i, 145, 927
Pass a Loutre, Mississippi River, sill across.....	i, 325; ii, 1276
Patapasco River, Md., and channel to Baltimore.....	i, 194; ii, 1027
Patapasco River, Md., channel to Curtis Bay.....	i, 196; ii, 1031
Patapasco River, Md., harbor of southwest Baltimore (Spring Garden).....	i, 197; ii, 1031
Pedee River, S. C.....	i, 245; ii, 1120
Plaquemine Bayou, La.....	i, 332; ii, 1289
Portage Lake, Mich., harbor of refuge.....	i, 517; iii, 1973
Portland Harbor, Me., including Back Cove.....	i, 51, 725
Potomac River below Washington, D. C.....	i, 200; ii, 1038
Providence River, R. I.....	i, 95, 801
Red Hook channel, New York Harbor, N. Y.....	i, 142, 915
Rockland Harbor, Me.....	i, 47, 721
Sacramento River, Cal.....	i, 587; iii, 2194
St. Johns River, Fla., Jacksonville to the ocean.....	i, 271, 976; ii, 1173
St. Joseph Harbor, Mich.....	i, 501; iii, 1937
St. Marys River, Mich., at the falls.....	i, 534; iii, 2006
St. Marys River, Mich., Hay Lake and Neebish channels.....	i, 537; iii, 2027
Sandbeach harbor of refuge, Mich.....	i, 526; iii, 1989
San Diego Harbor, Cal.....	i, 575; ii, 2171
San Francisco Harbor, Cal.....	i, 582; iii, 2184
San Joaquin River, Cal., Stockton and Mormon channels.....	i, 585; iii, 2193
San Pablo Bay, Cal.....	i, 583; iii, 2189
San Pedro Bay, Cal.....	i, 576; iii, 2173
Saugatuck Harbor, Mich.....	i, 504; iii, 1945
Savannah Harbor, Ga.....	i, 257, 980; ii, 1141
Savannah River, Ga., between Augusta and Savannah.....	i, 260; ii, 1152
Ship channel connecting waters of the Great Lakes.....	i, 532; iii, 2001
Ship Island Harbor, Miss., channel to Gulfport.....	i, 320; ii, 1266
South Chicago Harbor, Ill. (see Calumet Harbor).....	i, 493; iii, 1896
Southwest Baltimore Harbor, Md., at Spring Garden.....	i, 197; ii, 1031
Southwest Pass, Mississippi River.....	i, 326, 980; ii, 1277
Spring Garden, southwest Baltimore Harbor, Md.....	i, 197; ii, 1031
Staten Island Sound, N. Y. and N. J.....	i, 147, 932
Stockton channel, San Joaquin River, Cal.....	i, 585; iii, 2193

## Continuing contracts—Continued.

- Sturgeon Bay Canal, including harbor of refuge ..... I, 478; II, 1841  
 Superior Harbor, Wis ..... I, 466; II, 1794  
 Superior Lake to Keweenaw Bay, Mich., waterway ..... I, 471; II, 1815  
 Tacoma Harbor, Wash ..... I, 627; III, 2331  
 Tampa Bay, Fla ..... I, 284; II, 1198  
 Tennessee River, Ala., Colbert and Bee Tree shoals ..... I, 418; II, 1591, 1594  
 Toledo Harbor, Ohio ..... I, 542, 979; III, 2049  
 Tombigbee River, Ala., between mouth and Demopolis ..... I, 309; II, 1245  
 Trinity River, Tex., locks and dams ..... I, 354; II, 1338  
 Tug Fork, Big Sandy River, W. Va. and Ky ..... I, 448; II, 1742  
 Turners Cut, N. C., waterway via ..... I, 225; II, 1083  
 Union River, Me ..... I, 41, 715  
 Vicksburg Harbor, Miss ..... I, 370; II, 1385  
 Warrior River, Ala., above Tuscaloosa ..... I, 309; II, 1244  
 Warrior River, Ala., below Tuscaloosa ..... I, 309; II, 1245  
 Washita (Ouachita) River, Ark. and La ..... I, 366; II, 1373  
 Waukegan Harbor, Ill ..... I, 488; II, 1864  
 White River, Ark., locks and dams on upper portion ..... I, 381; II, 1420  
 Wilmington, Cal., outer harbor ..... I, 576; III, 2173  
 Wilmington, Del., harbor at ..... I, 174, 992  
 Winyah Bay, S. C ..... I, 246; II, 1122  
 Yazoo River, Miss., at the mouth ..... I, 370; II, 1385
- Contracts, continuing. *See* Continuing contracts.
- Conway, S. C., bridge across Waccamaw River ..... I, 650  
 Conway and Seashore Railroad Company, bridge of ..... I, 650  
 Cooper Creek, N. J.:  
   Improvement of ..... I, 167, 986  
   Removal of wreck ..... I, 194, 1024
- Coocha River, Ga. and Ala.:  
   Improvement above East Tenn., Va. and Ga. R. R. bridge.. I, 303, 304; II, 1230  
   Improvement below East Tenn., Va. and Ga. R. R. bridge.. I, 303, 305; II, 1233  
   Operating and care of locks and dams ..... I, 306; II, 1235
- Coosawattee River, Ga., improvement of ..... I, 303, 305; II, 1233
- Coos Bay, Harbor, and River, Oreg.:  
   Improvement of entrance to bay and harbor ..... I, 595; III, 2209  
   Improvement of river ..... I, 597; III, 2211
- Coquille River, Oreg., improvement of ..... I, 593; III, 2205
- Corney Bayou, La., improvement of ..... I, 368, 370; II, 1379
- Corps of Engineers:  
   Engineer equipment of troops and civilian assistants to engineer officers. I, 23, 697  
   Engineer School of Application ..... I, 19, 674, 675, 689; IV, 2934  
   Laws of 57th Congress, second session, affecting the ..... IV, 2943  
   Officers on duty in Office of the Chief of Engineers ..... I, 676  
   Personnel ..... I, 3, 5, 18, 669, 686; IV, 2906  
   Service of officers abroad and in the field, with troops ..... I, 24
- Coscob Harbor, Conn., improvement of ..... I, 122, 854
- Cottrell (schooner), removal of wreck of ..... I, 281; II, 1187
- Council Bluffs, Iowa, bridge across Missouri River to East Omaha, Nebr. .... I, 642
- Courtableau Bayou, La., improvement of ..... I, 334; II, 1295
- Cowlitz River, Wash.:  
   Bridge across ..... I, 648  
   Improvement of ..... I, 617; III, 2319
- Craft, water:  
   *See also* Dredge and Snag boats, and Wrecks.  
   Rules governing running of steamboats on certain streams ..... I, 641
- Craigs Point, Manatee River, Fla., bridge at ..... I, 643
- Croatan Sound, N. C., improvement of waterway via ..... I, 225; II, 1083
- Crooked (Carrabelle) River, Fla. (*see* Carrabelle bar and harbor) .... I, 290; II, 1207
- Cross Creek Township, W. Va., bridge across Ohio River to Steubenville, Ohio. .... I, 644
- Cross ledge light-house, Delaware Bay, removal of wreck ..... I, 165, 971
- Croydon, Pa., bridge across Neshaminy Creek ..... I, 646
- Crystal River, Fla., improvement of ..... I, 286; II, 1202
- Cumberland River, Tenn. and Ky.:  
   Bridge in Davidson County, Tenn ..... I, 643  
   Gauging (*see* Mississippi River Commission) ..... I, 639; S., 7, 8, 62, 97  
   Improvement above Nashville, Tenn ..... I, 414; II, 1585

## Cumberland River, Tenn. and Ky.—Continued.

- Improvement below Nashville, Tenn. .... i, 412; ii, 1581
- Removal of wreck at Dover Island Chute ..... i, 417; ii, 1589
- Cumberland Sound, Ga. and Fla.:
  - Improvement of, including dredge construction..... i, 270, 974; ii, 1168
  - Improvement of waterway between Savannah and Fernandina .. i, 269; ii, 1166
  - Removal of wrecks ..... i, 271; ii, 1171
- Cummings, Ill., bridge across Calumet River at..... i, 643, 644
- Current River, Ark., and Mo., improvement of..... i, 385; ii, 1434
- Currituck Sound, N. C., improvement of waterway via..... i, 226; ii, 1084
- Curtis Bay, Baltimore, Md., improvement of channel to ..... i, 196; ii, 1031
- Cut-off, Apalachicola River, Fla., improvement of..... i, 292; ii, 1212
- Cuyahoga River, Ohio. *See* Cleveland Harbor.
- Cypress Bayou, Tex. and La., improvement of ..... i, 365; ii, 1372

## D.

- Dade County, Fla., bridge of..... i, 646
- Daisy (bugeye), removal of wreck of..... i, 218; ii, 1071
- Daisy (flatboat), removal of wreck of, in Buffalo Bayou, Tex. .... i, 360, 361; ii, 1347
- Dalecarlia reservoir, Washington Aqueduct, D. C..... i, 654; iv, 2485
- Dams. *See* Canals and Waterways.
- D'Arbonne Bayou, La., improvement of ..... i, 368, 370; ii, 1379
- Darien Harbor, Ga., improvement of ..... i, 262; ii, 1156
- Davidson, Gen. William Lee, monument to ..... i, 676; iv, 2939
- Davis, Chas. H. (steamer), removal of wreck of..... i, 556; iii, 2105
- Davis Island dam, Ohio River, Pa.:
  - Operating and care ..... i, 435; ii, 1671
  - Survey of Pool No. 1 for increased depth and additional harbor facilities..... i, 434; ii, 1688
- Deal Island Harbor, Md., removal of wrecks ..... i, 194, 1024
- Débris, mining, in California ..... i, 638; iii, 2367
- Deep Creek Branch, Elizabeth River, Va., waterway via..... i, 225; ii, 1083
- Defenses, seacoast. *See* Fortifications.
- Delaware Bay and River, N. J., Pa., and Del.:
  - Defenses of ..... i, 9
  - Delaware Breakwater, Del., maintenance and repair of..... i, 163, 969
  - Harbor lines between Edgemoor and Christiana River ..... i, 640, 981
  - Harbor of refuge in bay, construction of..... i, 164, 970
  - Improvement of river..... i, 159, 957
  - Lewes, Del., iron pier near, maintenance and repair of ..... i, 163, 968
  - Marcushook, Pa., improvement of ice harbor ..... i, 166, 984
  - Waterway to Chincoteague Bay, Va., improvement of ..... i, 180, 1002
  - Wrecks, removal of..... i, 165, 971, 972
- Delta Point, La. (*see* Mississippi River Commission)..... i, 639; S., 3, 40
- Department of Justice. *See* Attorney-General.
- Departments, Executive, Washington, D. C., telegraph line and improvement of grounds..... i, 659; iv, 2517
- Departments, military, reconnaissances and explorations..... i, 667; iv, 2478, 2899
- Depots, engineer ..... i, 19, 21, 23, 694, 703, 705
- Derelicts. *See* Wrecks.
- Deschutes River, Wash.:
  - Bridge at Olympia..... i, 645
  - Improvement of Olympia Harbor..... i, 626; iii, 2330
- Des Glaises Bayou, La., bridges across ..... i, 648
- Des Moines Rapids Canal, Mississippi River:
  - Examination for enlargement of locks, with estimates of cost, and for dam at foot of rapids ..... ii, 1500
  - Operating and care of, including dry dock..... i, 395; ii, 1491
- Des Plaines River, Ill., survey for waterway from Lockport, Ill., to St. Louis, Mo..... i, 494, 639; iii, 1904; S., 7, 68, 167
- Details, technical, of engineering methods. *See* Technical details.
- Detroit River, Mich.:
  - Improvement of ..... i, 540; iii, 2036
  - Improvement of channels in waters connecting Great Lakes .... i, 532; iii, 2001
  - Survey from Detroit to Lake Erie, final report on ..... i, 542
  - Surveys, etc. (*see* Northern and Northwestern Lakes)..... i, 660; iv, 2671
- Disappearing gun carriages..... i, 10

- Discharge measurements. *See* Gauging.
- Dismal Swamp Canal, Va. and N. C., improvement of waterway via. i, 225; ii, 1083
- District of Columbia. *See* Washington.
- Dividing Creek (La Trappe River), Md., improvement of ..... i, 191, 1019
- Division, engineers ..... i, 36
- Division of the Philippines, reconnaissances and explorations ..... i, 663, 669; iv, 2478, 2903
- Divisions, engineer ..... i, 36
- Doboy bar, Ga., improvement of ..... i, 263; ii, 1156
- Dock lines. *See* Harbor lines.
- Dog River, Miss. (*see* Pascagoula River) ..... i, 315; ii, 1258
- Dora, Amy (steamer), removal of wreck of ..... i, 194, 1024
- Dossett, Tenn., bridge across Clinch River ..... i, 644
- Double Bayou, Tex., improvement of ..... i, 354; ii, 1339
- Dover Island Chute, Cumberland River, removal of wreck ..... i, 417; ii, 1589
- Drawbridges:  
*See also* Bridges.  
 Rules for opening of ..... i, 642
- Drawings. *See* Maps.
- Dredge boats recently authorized:
- Arkansas River ..... i, 376; ii, 1407
  - Ashtabula Harbor, Ohio ..... i, 553, 979
  - Charleston Harbor, S. C. .... i, 253, 972
  - Cleveland Harbor, Ohio ..... i, 549, 979
  - Columbia River, Oreg. and Wash., mouth of ..... i, 614, 975
  - Columbia River, Oreg. and Wash., from mouth to Willamette River ..... i, 612; iii, 2263
  - Conneaut Harbor, Ohio ..... i, 555, 979
  - Cumberland Sound, Ga. and Fla. .... i, 270, 974
  - Fairport Harbor, Ohio ..... i, 551, 979
  - Florida, works in ..... i, 280; ii, 1186
  - Fox River, Wis. .... i, 489; ii, 1866
  - Grand River, Mich. .... i, 509; iii, 1956
  - Key West Harbor, Fla. .... i, 278, 980
  - Michigan Lake, harbors on eastern shore ..... i, 498, 979
  - Mississippi River, Head of Passes to Ohio River ..... i, 639; S., 3, 40
  - Mississippi River, passes of ..... i, 325, 326, 973, 980; ii, 1276, 1277
  - Monongahela River, Pa. .... i, 429; ii, 1658
  - New York Harbor, N. Y. .... i, 139, 979
  - Pensacola Harbor, Fla. .... i, 299, 977
  - St. Johns River, Fla. .... i, 271, 976
  - Sandusky Harbor, Ohio ..... i, 545, 979
  - San Pedro (Wilmington), Cal., inner harbor ..... i, 577; iii, 2175
  - Savannah Harbor, Ga. .... i, 257, 980
  - Southwest Pass, Mississippi River ..... i, 325, 326, 980
  - Tennessee River below Riverton, Ala. .... i, 419; ii, 1591, 1598
  - Texas coast ..... i, 354; ii, 1339
  - Toledo Harbor, Ohio ..... i, 542, 979
  - Willamette River, Oreg., below Portland ..... i, 612; iii, 2257
  - Wilmington, Cal., inner harbor ..... i, 577; iii, 2175
- Dredge No. 3, removal of wreck of, in Galveston Bay, Tex. .... i, 360, 361; ii, 1347
- Duck Creek (Smyrna River), Del., improvement of ..... i, 179, 1000
- Duck Island Harbor, Conn., construction of harbor of refuge ..... i, 108, 838
- Duluth Canal and Harbor, Minn.:  
 Harbor lines in Lake Superior ..... i, 640; ii, 1828  
 Improvement of ..... i, 466; ii, 1794  
 Improvement of channels in waters connecting Great Lakes ..... i, 532; iii, 2001  
 Removal of wrecks in Lake Superior ..... ii, 1828
- Dunbar, George (steamer), removal of wreck of ..... i, 556; iii, 2103
- Dunkirk Harbor, N. Y., improvement of ..... i, 558; iii, 2124
- Dunnellon Phosphate Company, improvement of Withlacoochee River by ..... i, 289; ii, 1203
- Duwamish River, Wash. (*see* Puget Sound) ..... i, 625; iii, 2328
- Duxbury Harbor, Mass., improvement of ..... i, 85, 781
- Dyer County, Tenn., bridge of ..... i, 646



## E.

- East (Ambrose) channel, New York Harbor, N. Y., improvement of. i, 139, 909, 979  
 East Chester Bay, N. Y., bridge in Pelham Bay Park. i, 650  
 East Chester Creek, N. Y., improvement of. i, 127, 864  
 East, department of the, reconnaissances and explorations. i, 668; iv, 2902  
 Eastern Branch, Elizabeth River, Va. (*see* Norfolk Harbor). i, 219; ii, 1074  
 Eastern Branch, Potomac River. *See* Anacostia River.  
 East Omaha, Nebr., bridge across Missouri River to Council Bluffs, Iowa. i, 642  
 East Pass, Carrabelle Harbor, Fla., improvement of. i, 290; ii, 1207  
 East River, Ga. (*see* Brunswick Harbor). i, 267; ii, 1164  
 East River, N. Y.:  
   Harbor lines at North Brother Island, Lawrence Point, and Berrian  
   Island, and between East Thirteenth and East Eighteenth streets,  
   New York City. i, 640, 888, 891, 895  
   Improvement of. i, 131, 871  
   Removal of wreck. i, 139, 887  
 Echo Bay Harbor, N. Y., improvement of. i, 126, 861  
 Eddy, D. M., bridge of. i, 648  
 Edenton Bay, N. C., improvement of. i, 227; ii, 1086  
 Edgemoor, Del., harbor lines in Delaware River to Christiana River. i, 640, 981  
 Edisto (South) River, S. C., waterway via, with estimates of cost. i, 255; ii, 1132  
 Eel River, Mass. (*see* Plymouth Harbor). i, 86, 782  
 Eighteen-mile Creek, N. Y. (*see* Olcott Harbor). i, 566; iii, 2151  
 Eldorado (barge), removal of wreck of. i, 158, 954  
 Eldorado and Bastrop Railway Company, bridge of. i, 643  
 Electrical connections at fortifications. i, 14, 15, 16, 17  
 Elizabeth, Pa., harbor lines in Monongahela River. i, 640; ii, 1698  
 Elizabethport, N. J., removal of wreck in Arthur Kill. i, 158, 159, 955  
 Elizabeth River, N. J.:  
   Improvement of. i, 154, 947  
   Removal of wreck. i, 159, 955  
 Elizabeth River, Va.:  
   Harbor lines at Atlantic City bridge, at mouth of Smith Creek. i, 640; ii, 1089  
   Improvement of Norfolk Harbor and its approaches, including Hos-  
   pital Point. i, 219; ii, 1074  
   Improvement of waterway to Albemarle Sound, via Currituck  
   Sound. i, 226; ii, 1084  
   Improvement of waterway to sounds of North Carolina, via Pasquotank  
   River. i, 225; ii, 1083  
   Improvement of Western Branch. i, 220; ii, 1076  
 Elkpoint, S. Dak. (*see* Missouri River). i, 405; ii, 1551  
 Elk River, Md., improvement of. i, 182, 1003  
 Elk River, W. Va., improvement of. i, 446; ii, 1729  
 Embankments. i, 13, 16, 17  
 Emlin, C. (steamer), removal of wreck of. i, 306; ii, 1236  
 Emory River, Tenn., bridge at Harriman. i, 643  
 Emplacements. i, 10, 11  
 Employees as civilian assistants to engineer officers. i, 23  
 Endicott Board. i, 8, 9  
 Engineer depots. i, 19, 21, 23, 694, 703, 705  
 Engineer divisions. i, 36  
 Engineer equipment of troops. i, 23, 697  
 Engineering methods, technical details of. *See* Technical details.  
 Engineer officers, civilian assistants to. i, 23  
 Engineer School of Application. i, 19, 674, 675, 689; iv, 2934  
 Engineer troops. *See* Troops.  
 Engineers, Battalions of. i, 5, 18, 686; iv, 2906  
 Engineers, Boards of. *See* Boards.  
 Engineers, Corps of:  
   Engineer equipment of troops and civilian assistants to engineer offi-  
   cers. i, 23, 697  
   Engineer School of Application. i, 19, 674, 675, 689; iv, 2934  
   Laws of 57th Congress, second session, affecting the. iv, 2943  
   Officers on duty in Office of the Chief of Engineers. i, 676  
   Personnel. i, 3, 5, 18, 669, 686; iv, 2906  
   Service of officers abroad and in the field, with troops. i, 24

- Engineers, division ..... 1, 36  
 Engineers, Office of the Chief of, officers on duty ..... 1, 676  
 Engineers, The Board of ..... 1, 8, 679  
 English Bayou, La., bridge across ..... 1, 647  
 Equipment, engineer, of troops ..... 1, 23, 697  
 Erie Basin, Buffalo, N. Y.:  
     Improvement of Buffalo entrance to ..... 1, 562; III, 2143  
     Improvement of Lake Erie entrance to ..... 1, 562; III, 2142  
 Erie Harbor, Pa., improvement of, use of land at Presque Isle Peninsula for  
     water-supply purposes, and status of title ..... 1, 557; III, 2115  
 Erie Lake (*see also* Northern and Northwestern Lakes):  
     Dredge boat for harbors on. *See* Dredge boats, etc.  
     Removal of wrecks ..... 1, 556; III, 2103  
     Water levels ..... 1, 665; IV, 2678  
 Escambia River, Fla., improvement of ..... 1, 301; II, 1226  
 Esopus Creek, N. Y. (*see* Saugerties Harbor) ..... 1, 136, 883  
 Estherville-Minim Creek Canal, S. C. (*see* Santee River) ..... 1, 248; II, 1127  
 Estimates of appropriations required:  
     Fortifications ..... 1, 17  
     Rivers and harbors, etc ..... 1, 36, 636  
 Eureka, Cal. (*see* Humboldt Harbor) ..... 1, 591; III, 2199  
 Evansville, Ind. (*see* Ohio River) ..... 1, 423; II, 1627  
 Evaporation, outflow, and rainfall in valley of Northern and Northwestern  
     Lakes ..... 1, 665; IV, 2855  
 Everett, Mass., bridge across Malden River to Medford ..... 1, 650  
 Everett Harbor, Wash., improvement of ..... 1, 631; III, 2334  
 Examinations of rivers and harbors:  
     Estimate of appropriation for ..... 1, 636  
     Required to be made by act of 1902 ..... 1, 36  
 Executive Departments, Washington, D. C., telegraph line and improve-  
     ment of grounds ..... 1, 659; IV, 2517  
 Executive Mansion and office, Washington, D. C. .... 1, 658; IV, 2517  
 Exeter River, N. H., improvement of ..... 1, 57, 735  
 Explorations and reconnaissances, military, with report on technical fea-  
     tures of engineer operations in the former department of North Philip-  
     pines, and present Department of Luzon ..... 1, 667; IV, 2478, 2903
- F.**
- Fairhaven Harbor, Mass.:  
     Harbor lines ..... 1, 640, 820  
     Improvement of New Bedford Harbor ..... 1, 92, 794  
 Fairmont, W. Va., bridge across Monongahela River ..... 1, 651  
 Fairport Harbor, Ohio:  
     Improvement of, including dredge construction ..... 1, 551, 979; III, 2084  
     Removal of wreck ..... 1, 556; III, 2106  
 Fairy Lake, Tex. and La. (*see* Cypress Bayou) ..... 1, 365; II, 1372  
 Falia, Bogue, La., improvement of ..... 1, 337; II, 1301  
 Fall River Harbor, Mass., improvement of ..... 1, 97, 803  
 Falls of Ohio River, Louisville, Ky.:  
     Improvement of ..... 1, 452; II, 1763  
     Operating and care of Louisville and Portland Canal ..... 1, 455; II, 1765  
 False Egg Island Point, Delaware Bay, removal of wreck ..... 1, 165, 971  
 Feather River, Cal.:  
     Improvement of ..... 1, 587; III, 2194  
     Improvement of, by California Débris Commission ..... 1, 638; III, 2368  
 Fenwicks Island shoal, Md., removal of wreck ..... 1, 194, 1024  
 Fernandina, Fla.:  
     Improvement of Cumberland Sound ..... 1, 270; II, 1168  
     Improvement of waterway to Savannah, Ga ..... 1, 269; II, 1166  
 Ferry Crossing, Caloosahatchee River, Alva, Fla., bridge at ..... 1, 647  
 Ferry (Fairy) Lake, Tex. and La. (*see* Cypress Bayou) ..... 1, 365; II, 1372  
 Fidelia (barge), removal of wreck of ..... 1, 103, 820  
 Field:  
     Reconnaissances, explorations, etc., in the ..... 1, 667; IV, 2478, 2899  
     Services of officers of the Corps of Engineers in the, with troops ..... 1, 24  
 Filtration plant, Washington Aqueduct, D. C., with report concerning pre-  
     liminary treatment of Potomac water ..... 1, 657; IV, 2505, 2511  
 Finders, range and position ..... 1, 12, 15, 17

- Fire Island Inlet, N. Y. (*see* Great South Bay) ..... i, 134, 875  
 Fisher, Antoinette (barge), removal of wreck of ..... i, 159, 955  
 Fisher, Leon (barge), removal of wreck of ..... i, 159, 955  
 Fishing Creek, N. C., improvement of ..... i, 230; ii, 1093  
 Five-mile River Harbor, Conn., improvement of ..... i, 119, 850  
 Flag River, Wis. (*see* Portwing Harbor) ..... i, 468; ii, 1809  
 Flat Lake, La. (*see* Grand River) ..... i, 332; ii, 1289, 1312  
 Flint River, Ga., improvement of ..... i, 295; ii, 1215  
 Flint River, Mich., improvement of ..... i, 525; iii, 1986  
 Florence, Oreg., examination and survey of Siuslaw River at and  
     near ..... i, 599; iii, 2229  
**Florida:**  
     Defenses of coast, including report on damp proofing ..... i, 9; iv, 2413  
     Dredge boat for Key West Harbor ..... i, 278, 980  
     Dredge boat for Pensacola Harbor ..... i, 299, 977  
     Dredge boat for St. Johns River ..... i, 271, 976  
     Dredge and snag boat for works in ..... i, 280; ii, 1186  
     Removal of water hyacinths from waters in, including report on experi-  
         ments made ..... i, 279; ii, 1184; iv, 2433  
 Florida Coast Line Canal and Transportation Company (*see* Indian  
     River) ..... i, 276; ii, 1181  
 Florida East Coast Railway Company:  
     Construction of basin at Miami, Fla., by ..... i, 277; ii, 1182  
     Construction of bridge by ..... i, 648  
 Florida Southern Railroad Company, bridge of ..... i, 649  
 Flushing Bay, N. Y., improvement of ..... i, 129, 868  
 Footbridge across Potomac River at Washington, D. C., to replace Long  
     Bridge ..... i, 643, 653; iv, 2484  
 Foote, Fort, Potomac River, Md. .... i, 17, 18, 685  
 Foreign possessions. *See* Insular possessions.  
 Fore River, Mass. *See* Weymouth River.  
 Forked Deer River, Tenn., improvement of ..... i, 411; ii, 1579  
 Fort Foote, Potomac River, Md. .... i, 17, 18, 685  
 Fort Gibson, Ind. T., bridge across Arkansas River near ..... i, 642  
**Fortifications (*see also* Technical details):**  
     Appropriations required for 1904-5, estimates of ..... i, 17  
     Board of Engineers, The ..... i, 8, 679  
     Board of Ordnance and Fortification ..... i, 8, 9, 12, 16  
     Board on Fortifications or other Defenses (Endicott Board) ..... i, 8, 9  
     Building for School of Submarine Defense ..... i, 13, 16  
     Carriages, gun and mortar ..... i, 10  
     Financial statement ..... i, 14  
     General statement, suggestions, and progress of work ..... i, 8, 9  
     Gun and mortar batteries ..... i, 9, 14, 17  
     Insular possessions ..... i, 8, 9, 14, 17  
     Preservation and repair of ..... i, 12, 15, 17  
     Projects ..... i, 8, 9, 16, 17  
     Range and position finders ..... i, 12, 15, 17  
     Searchlights and electrical connections, with notes on project-  
         ors ..... i, 14, 15, 16, 17; iv, 2425  
     Sea walls and embankments ..... i, 13, 16, 17  
     Sites ..... i, 13, 14, 15, 17  
     Submarine mines ..... i, 13, 15, 17  
     Supplies for seacoast defenses ..... i, 12, 16, 17  
**Fort Leavenworth, Kans.:**  
     Engineer depot at ..... i, 21, 23, 703  
     Engineer troops at ..... i, 5  
**Fort Lee, N. J., harbor lines in Hudson River.** ..... i, 640, 905  
**Fort Pierre, S. Dak. (*see* Missouri River)** ..... i, 405; ii, 1551  
**Fort Point channel, Boston, Mass.:**  
     Bridges at Congress street and Mount Washington avenue ..... i, 652  
     Improvement of ..... i, 79, 767  
**Fort Totten, N. Y., building for School of Submarine Defense.** ..... i, 13, 16  
**Fort Washakie, Wyo., road to Buffalo Fork, Snake River** ..... i, 675; iv, 2937  
**Fort William McKinley, Manila Bay, P. I.** ..... iv, 2481, 2907  
**Fox River, Wis.:**  
     Bridge at Appleton ..... i, 646  
     Bridge at Oshkosh ..... i, 645

## Fox River, Wis.—Continued.

- Harbor lines at Oshkosh and Greenbay ..... i, 640; ii, 1883, 1884
- Improvement of ..... i, 489; ii, 1866
- Improvement of Greenbay Harbor ..... i, 477; ii, 1839
- Operating and care of locks and dams ..... i, 491; ii, 1870
- Franconia (vessel), removal of wreck of ..... i, 271; ii, 1171
- Frankfort Harbor, Mich., improvement of ..... i, 518; iii, 1975
- Franklin, La., bridge across Bayou Teche ..... i, 650
- Franklin, Pa.:
  - Bridge across Allegheny River at (county bridge) ..... i, 651
  - Bridge across Allegheny River near (Big Rock Bridge) ..... i, 651
- Franklinton, La., bridge across Bogue Chitto ..... i, 650
- French Broad River, Tenn., improvement of ..... i, 420; ii, 1616
- Frenchman Bay, Me., defenses of, including report on telephone booths and damp-proofing ..... i, 9; iv, 2371
- Friend, Lottie K. (schooner), removal of wreck of ..... i, 165, 972

## G.

- Galena River, Ill., operating and care of lock and dam ..... i, 395; ii, 1498
- Gallipolis, Ohio, ice pier (*see* Ohio River) ..... i, 423; ii, 1627
- Galveston and Brazos Canal, Tex., purchase of ..... i, 355; ii, 1339
- Galveston Bay and Harbor, Tex.:
  - Defenses of, including report on damp-proofing ..... i, 9, 16; iv, 2416
  - Improvement of Galveston-Texas City channel ..... i, 351; ii, 1331
  - Improvement of harbor ..... i, 348; ii, 1321
  - Improvement of harbor from inner bar to Fifty-first street ..... i, 350; ii, 1328
  - Improvement of waterway to Houston ..... i, 351; ii, 1334
  - Improvement of West Bay ..... i, 354, 356; ii, 1339
  - Plan and estimate of cost of protection of harbor, etc., from storms ..... i, 349; ii, 1348
  - Removal of wrecks ..... i, 360, 361; ii, 1347
- Galveston, Harrisburg and San Antonio Railway Company, bridge of ..... i, 647, 648
- Gasconade River, Mo., improvement of ..... i, 409; ii, 1574
- Gauging:
  - Columbia River, Oreg. and Wash. .... i, 619; iii, 2321
  - Michigan Lake, variations in surface level on east shore ..... i, 498
  - Mississippi River and principal tributaries ..... i, 405, 639; ii, 1549; S., 7, 8, 62, 97
  - Northern and Northwestern Lakes, including report on outflow, rainfall, and evaporation ..... i, 665; iv, 2678, 2855
- Ganley River, W. Va., improvement of ..... i, 446; ii, 1728
- Gedney channel, New York Harbor, N. Y., improvement of ..... i, 139, 909
- Genesee River, N. Y. (*see* Charlotte Harbor) ..... i, 567; iii, 2153
- George Lake, St. Johns River, Fla. (*see* Volusia bar) ..... i, 274; ii, 1179
- Georges River, Me., improvement of ..... i, 49, 723
- Georgetown, D. C. *See* Washington, D. C.
- Georgetown Harbor, S. C. (*see* Winyah Bay) ..... i, 246; ii, 1122
- Gibson, Fort, Ind. T., bridge across Arkansas River near ..... i, 642
- Gillen, Edward (tug), removal of wreck of ..... ii, 1828
- Glencove Harbor, N. Y., improvement of ..... i, 129, 867
- Glenifer (schooner), removal of wreck of ..... i, 542; iii, 2046
- Gloucester Harbor, Mass., improvement of ..... i, 65, 744
- Golconda, Ill. (*see* Ohio River) ..... i, 423; ii, 1627
- Golden Gate, Cal., channel to Marquines Straits (*see* San Pablo Bay) ..... i, 583; iii, 2189
- Goshen Creek, N. J., improvement of ..... i, 170, 989
- Gosport Harbor, N. H. (*see* Isles of Shoals Harbor) ..... i, 55, 733
- Government Printing Office, Washington, D. C.:
  - Construction of new building for ..... i, 673; iv, 2919
  - Telegraph line ..... i, 659; iv, 2517
- Government telegraph line, Washington, D. C. .... i, 659; iv, 2517
- Governors Island, New York Harbor, N. Y., enlargement of ..... i, 144, 920
- Gowanus Bay, Canal, and Creek, N. Y.:
  - Bay Ridge and Red Hook channels, including Gowanus Canal, improvement of ..... i, 142, 915
  - Gowanus Creek, removal of wreck ..... i, 145, 924
  - Gowanus Creek channel, improvement of ..... i, 143, 919
- Grand Calumet River, Ill. and Ind. (*see* Calumet River) ..... i, 494; iii, 1901

- Grand Haven Harbor, Mich.:  
 Bridge across Grand River to Spring Lake ..... I, 649  
 Improvement of ..... I, 508; III, 1952
- Grand Marais, Mich., improvement of harbor of refuge ..... I, 474; II, 1824
- Grand Marais, Minn., improvement of harbor ..... I, 464; II, 1791
- Grand Rapids, Mich.:  
 Bridge across Grand River ..... I, 646  
 Improvement of Grand River ..... I, 509; III, 1956
- Grand Rapids, Wabash River, lock and dam ..... I, 457, 459; II, 1772, 1773
- Grand River, La., improvement of ..... I, 332; II, 1289, 1312
- Grand River, Mich.:  
 Bridge at Grand Rapids ..... I, 646  
 Bridge between Spring Lake and Grand Haven ..... I, 649  
 Improvement of ..... I, 509; III, 1956  
 Improvement of Grand Haven Harbor ..... I, 508; III, 1952
- Grand River, Ohio (*see* Fairport Harbor) ..... I, 551, 979; III, 2084
- Grand River Toll Bridge Company, bridge of ..... I, 649
- Grant statue, Washington, D. C. .... I, 658; IV, 2517
- Grant (Army transport), conversion of, into dredge ..... I, 614, 975
- Grays Harbor, Wash.:  
 Improvement of, between Aberdeen and the entrance ..... I, 623; III, 2327  
 Improvement of, including bar entrance ..... I, 621; III, 2325
- Great Kanawha River, W. Va.:  
 Improvement of ..... I, 444; II, 1721  
 Operating and care of locks and dams ..... I, 445; II, 1723
- Great Lakes:  
 Commercial statistics, Sault Ste. Marie canals, Mich ..... I, 535; III, 2010, 2015  
 Defenses of ..... I, 8, 9  
 Dredge boat for harbors on Lake Erie. *See* Dredge boats, etc.  
 Dredge boat for harbors on eastern shore of Lake Michigan ..... I, 498, 979  
 Improvement of channels in waters connecting ..... I, 532; III, 2001  
 Outflow, rainfall, and evaporation in valley of ..... I, 666; IV, 2855  
 Survey of waters connecting lakes Superior and Huron, final report on ..... I, 542  
 Surveys and charts, with complete list of permanent and temporary  
 bench marks ..... I, 660, 665; IV, 2671, 2693  
 Water levels ..... I, 665; IV, 2678  
 Water levels on east shore of Lake Michigan, variations in ..... I, 498
- Great Pedee River, S. C., improvement of ..... I, 245; II, 1120
- Great Salt Pond, Block Island, R. I., improvement of ..... I, 102, 817
- Great Sodus Bay, N. Y., improvement of harbor ..... I, 568; III, 2155
- Great South Bay, N. Y., improvement of ..... I, 134, 875
- Greenbay Harbor, Fox River, Wis.:  
 Harbor lines ..... I, 640; II, 1884  
 Improvement of ..... I, 477; II, 1839
- Greene, Marion A. (schooner), removal of wreck of ..... I, 228; II, 1088
- Green Jacket shoal, Providence River, R. I., removal of ..... I, 96, 803
- Greenleaf Bend, Mississippi River, Ill., prevention of break into Cache  
 River ..... I, 392; II, 1455
- Green River, Ky.:  
 Improvement above mouth of Big Barren River ..... I, 461; II, 1775  
 Operating and care of locks and dams ..... I, 461; II, 1776
- Green Run Inlet life-saving station, Md., removal of wreck ..... I, 194, 1023
- Greensboro, N. C., monuments to Generals Nash and Davidson in Guilford  
 battle grounds near ..... I, 676; IV, 2939
- Greenville Harbor, Miss. (*see* Mississippi River Commission) ..... I, 639; S., 3, 40
- Greenwich Harbor, Conn., improvement of ..... I, 121, 851
- Grounds, public buildings and, District of Columbia ..... I, 658; IV, 2517
- Guam Island, defenses of ..... I, 8, 9, 14, 17
- Guilford battle grounds, N. C., monuments to Generals Nash and David-  
 son ..... I, 676; IV, 2939
- Gulfport, Miss., improvement of channel to Ship Island Harbor ..... I, 320; II, 1266
- Gulf States:  
 Removal of water hyacinths from Florida waters, including report on  
 experiments made ..... I, 279; II, 1184; IV, 2433  
 Removal of water hyacinths from Louisiana waters ..... I, 343; II, 1312  
 Removal of water hyacinths from Texas waters ..... I, 343
- Gun and mortar batteries ..... I, 9, 14, 17

Gut, the, South Bristol, Me., bridge across .....	i, 652
Guttenberg, N. J., harbor lines in Hudson River .....	i, 640, 905
Guyandot River, W. Va.:	
Bridge in Lincoln County .....	i, 646
Improvement of .....	i, 448; ii, 1741

## H.

Hainesport, N. J., bridge across Rancocas River .....	i, 647
Hall, Willie Lee (schooner), removal of wreck of .....	i, 228; ii, 1088
Hampton Roads, Va.:	
Defenses of .....	i, 9
Improvement of .....	i, 221; ii, 1076
Improvement of approaches to Norfolk Harbor .....	i, 219; ii, 1074
Removal of wreck .....	i, 228; ii, 1088
Handkerchief shoal, Mass., removal of wreck .....	i, 103, 820
Harbor Beach, Mich.:	
Improvement of Sandbeach harbor of refuge .....	i, 526; iii, 1989
Water levels at Sandbeach .....	i, 665; iv, 2678
Harbor lines, establishment of .....	i, 640
Acushnet River, Mass., at New Bedford and Fairhaven .....	i, 640, 820
Albany, N. Y. ....	i, 640, 901
Allegheny River, Pa. ....	i, 640; ii, 1706, 1709
Arthur Kill, N. Y. and N. J., recommendation for stone monuments to mark established lines .....	i, 141
Atlantic City bridge, Norfolk Harbor, Va. ....	i, 640; ii, 1089
Baltimore Harbor, Md., at Sparrow Point .....	i, 640; ii, 1033
Berrian Island, East River, N. Y. ....	i, 640, 891
Brooklyn, N. Y., Newtown Creek .....	i, 640, 898
China Basin, San Francisco Harbor, Cal., north of .....	i, 640; iii, 2202
Delaware River, between Edgemoor and Christiana River, Del. ....	i, 640, 981
Duluth Harbor, Minn. ....	i, 640; ii, 1828
East River, N. Y., at North Brother Island, Lawrence Point, and Berrian Island, and between East Thirteenth and East Eighteenth streets, New York City .....	i, 640, 888, 891, 895
Edgemoor, Del. ....	i, 640, 981
Elizabeth, Pa. ....	i, 640; ii, 1698
Elizabeth River, Va. ....	i, 640; ii, 1089
Fairhaven Harbor, Mass. ....	i, 640, 820
Fort Lee to Guttenberg, N. J. ....	i, 640, 905
Fox River, Wis. ....	i, 640; ii, 1883, 1884
Greenbay Harbor, Wis. ....	i, 640; ii, 1884
Guttenberg to Fort Lee, N. J. ....	i, 640, 905
Hazelwood, Pa. ....	i, 640; ii, 1702
Hudson River at Albany, N. Y. ....	i, 640, 901
Hudson River from Fort Lee to Guttenberg, N. J. ....	i, 640, 905
Jacksonville, Fla. ....	i, 640; ii, 1187
Kill van Kull, N. Y., recommendation for stone monuments to mark established lines along Staten Island .....	i, 141
Lawrence Point, East River, N. Y. ....	i, 640, 891
Lee, Fort, to Guttenberg, N. J. ....	i, 640, 905
Lermonds Cove, Rockland Harbor, Me. ....	i, 640, 727
Maumee River, Ohio. ....	i, 640; iii, 2107
Mission rock, San Francisco Harbor, Cal., north of .....	i, 640; iii, 2202
Mississippi River, at St. Louis, Mo. ....	i, 640; ii, 1455
Mississippi River, at St. Paul, Minn. ....	i, 640; ii, 1513
Monongahela River, Pa. ....	i, 640; ii, 1698, 1702, 1706
New Bedford Harbor, Mass. ....	i, 640, 820
Newbern, N. C. ....	i, 640; ii, 1114
Newtown Creek, N. Y., east branch .....	i, 640, 898
New York Harbor, East River, N. Y. ....	i, 640, 888, 891, 895
New York Harbor, Hudson River from Fort Lee to Guttenberg, N. J. ....	i, 640, 905
New York Harbor, Newtown Creek at Brooklyn, N. Y. ....	i, 640, 898
Norfolk Harbor, Va. ....	i, 640; ii, 1089
North Brother Island, East River, N. Y. ....	i, 640, 888
North (Hudson) River, from Fort Lee to Guttenberg, N. J. ....	i, 640, 905

## Harbor lines, establishment of—Continued.

- Oshkosh, Wis ..... i, 640; ii, 1883  
 Patapsco River at Sparrow Point, Md ..... i, 640; ii, 1033  
 Pawtucket (Seekonk) River, R. I ..... i, 640, 825  
 Pittsburg Harbor, Pa ..... i, 640; ii, 1702, 1706, 1709  
 Providence Harbor and River, R. I., including Pawtucket (Seekonk) River ..... i, 640, 825  
 Rockland Harbor, Me ..... i, 640, 727  
 St. Johns River, Fla ..... i, 640; ii, 1187  
 St. Louis Harbor, Mo ..... i, 640; ii, 1455  
 St. Paul Harbor, Minn ..... i, 640; ii, 1513  
 San Francisco Harbor, Cal ..... i, 640; iii, 2202  
 Seekonk (Pawtucket) River, R. I ..... i, 640, 825  
 Smith Creek, Norfolk Harbor, Va ..... i, 640; ii, 1089  
 Sparrow Point, Patapsco River, Md ..... i, 640; ii, 1033  
 Staten Island, N. Y., recommendation for stone monuments to mark established lines along ..... i, 141  
 Superior Lake, at Duluth, Minn ..... i, 640; ii, 1828  
 Toledo Harbor, Ohio ..... i, 640; iii, 2107  
 Trent River, N. C ..... i, 640; ii, 1114  
 Wilson, Pa ..... i, 640; ii, 1698
- Harbors and rivers. See Rivers and harbors.**  
 Hardings Beach light, Chatham, Mass., removal of wreck ..... i, 103, 820  
 Hargraves, R. & T. (schooner), removal of wreck of ..... i, 194, 1026  
 Harlem River, N. Y., improvement of ..... i, 132, 872  
 Harlowe Creek, N. C., improvement of waterway via ..... i, 235; ii, 1101  
 Harriman, Tenn., bridge across Emory River ..... i, 643  
 Harris, Anna M. (schooner), removal of wreck of ..... i, 218; ii, 1071  
 Harrisburg, Tex., bridge across Brays Bayou ..... i, 647, 648  
 Harris, Elsie M. (schooner), removal of wreck of ..... i, 194, 1023  
 Hartford, Conn.:  
   Bridge across Connecticut River at ..... i, 644  
   Improvement of Connecticut River below ..... i, 107, 836  
 Hartford, W. Va., ice harbor (*see* Ohio River) ..... i, 423; ii, 1627  
 Harvesta chemical compound, use of ..... i, 279, 343; ii, 1184, 1312; iv, 2433  
 Hat Slough, Wash. (*see* Puget Sound) ..... i, 625; iii, 2328  
 Havre de Grace, Md., improvement of Susquehanna River ..... i, 183, 1004  
**Hawaiian Islands:**  
   Defenses of ..... i, 8, 9, 14, 17  
   Improvement of Pearl Harbor ..... i, 592; iii, 2201  
 Hay Lake channel, St. Marys River, Mich.:  
   Final report on survey ..... i, 542  
   Improvement of ..... i, 537; iii, 2027  
   Improvement of channels in waters connecting Great Lakes ..... i, 532; iii, 2001  
 Hazelwood, Pa., harbor lines in Monongahela River ..... i, 640; ii, 1702  
 Helena Harbor, Ark. (*see* Mississippi River Commission) ..... i, 639; S., 3, 40  
 Hell Gate, East River, N. Y., improvement of ..... i, 131, 871  
 Hempstead, N. Y. (*see* Glencove Harbor) ..... i, 129, 867  
 Hen and Chickens light-ship, Mass., removal of wreck ..... i, 104, 820  
 Henry C. (barge), removal of wreck of ..... i, 194, 1024  
 Henry, Cape, Va., defenses at ..... i, 9  
 Herr Island, Allegheny River, Pa.:  
   Bridge across back channel ..... i, 649  
   Lock and dam at ..... i, 438, 439; ii, 1680, 1683  
 Highway bridge across Potomac River at Washington, D. C., to replace Long Bridge ..... i, 643, 653; iv, 2484  
 Hillsboro Bay and River, Fla., improvement of ..... i, 285; ii, 1200  
 Hiwassee River, Tenn., improvement of ..... i, 422; ii, 1622  
 Hoboken, N. J., removal of wreck ..... i, 139, 887  
 Hockingport, Ohio, ice harbor in Ohio River ..... i, 423; ii, 1627  
 Hoffman Island, New York Harbor, N. Y., removal of wreck ..... i, 145, 925  
 Holland Harbor, Mich., improvement of ..... i, 506; iii, 1948  
 Holmes River, Fla., improvement of ..... i, 298; ii, 1222  
 Holston River, Va. and Tenn., improvement of ..... i, 423; ii, 1624  
 Home City, Ohio, Lock and Dam 37, Ohio River ..... i, 426; ii, 1645  
 Homochitto River, Miss., improvement of ..... i, 335; ii, 1299  
 Honolulu Harbor, Hawaii, defenses of ..... i, 8, 9, 14, 17

- Hookton, Cal. (*see* Humboldt Harbor) ..... i, 591; III, 2199  
 Hopefield Bend, Mississippi River (*see* Mississippi River Commission) i, 639; S., 3, 40  
 Hoquarten Slough, Oreg. (*see* Tillamook Bay) ..... i, 601; III, 2216  
 Horn Island Harbor, Miss., improvement of ..... i, 315; II, 1258  
 Hospital Point, Norfolk Harbor, Va., removal of ..... i, 220; II, 1074  
 Housatonic River, Conn., improvement of ..... i, 114, 844  
 House Committee on Rivers and Harbors. *See* Committee, etc.  
 Houston, Tex., improvement of waterway to Galveston ..... i, 351; II, 1334  
 Houston, Beaumont and New Orleans Railroad Company, bridges of ..... i, 648  
 Howard University reservoir, Washington, D. C. .... i, 654, 655; IV, 2485, 2499  
 Hudson River, N. Y. and N. J.:  
     *See also* New York City and Harbor.  
     Albany, N. Y., harbor lines ..... i, 640, 901  
     Fort Lee to Guttenberg, N. J., harbor lines ..... i, 640, 905  
     Improvement of ..... i, 135, 877  
     Peekskill Harbor, N. Y., improvement of ..... i, 137, 885  
     Rondout Harbor, N. Y., improvement of ..... i, 137, 884  
     Saugerties Harbor, N. Y., improvement of ..... i, 136, 883  
     Wrecks, removal of ..... i, 139, 887, 888  
 Humboldt Harbor and Bay, Cal., improvement of ..... i, 591; III, 2199  
 Humptulips River, Wash., bridge across ..... i, 651  
 Huntington Harbor, N. Y., improvement of ..... i, 128, 866  
 Huron Harbor, Ohio, improvement of ..... i, 546; III, 2061  
 Huron Lake (*see also* Northern and Northwestern Lakes):  
     Final report on survey of waterway to Lake Superior ..... i, 542  
     Improvement of harbor of refuge at Sandbeach, Mich. .... i, 526; III, 1989  
     Water levels ..... i, 665; IV, 2678  
 Hutchinson River (East Chester Creek), N. Y., improvement of ..... i, 127, 864  
 Hyacinths, water:  
     Removal of, from Florida waters, including report on experiments  
         made ..... i, 279; II, 1184; IV, 2433  
     Removal of, from Louisiana waters ..... i, 343; II, 1312  
     Removal of, from Texas waters ..... i, 343  
 Hyannis, Mass.:  
     Improvement of harbor of refuge ..... i, 88, 788  
     Removal of wreck in harbor ..... i, 103, 819  
 Hydraulic mining in California ..... i, 638; III, 2367  
 Hydraulics. *See* Gauging.  
 Hydrology. *See* Gauging.  
 Hyers Run, W. Va., bridge across Little Kanawha River ..... i, 649

## I.

- I and J streets waterway, Whatcom, Wash., bridge across ..... i, 645, 646  
 Ida May (canal boat), removal of wreck of ..... i, 194, 1023  
 Illinois and Mississippi Canal, Ill.:  
     Construction of ..... i, 496; III, 1920  
     Operating and care ..... i, 395; II, 1496  
 Illinois Central Railroad Company, bridge of ..... i, 645  
 Illinois River, Ill.:  
     Bridge at Chillicothe ..... i, 647  
     Improvement of ..... i, 495; III, 1915  
     Operating and care of locks and dams ..... i, 496; III, 1917  
     Survey for waterway from Lockport, Ill., to St. Louis,  
         Mo. .... i, 494, 639; III, 1904; S., 7, 68, 167  
 Indiana Chute, Falls of Ohio River, improvement of ..... i, 452; II, 1763  
 Indian River, Fla., improvement of ..... i, 276; II, 1181  
 Indian River, Mich., bridge across ..... i, 648  
 Indian River Bay, Del., waterway via ..... i, 180, 1002  
 Indian River Inlet, Fla. (*see* Indian River) ..... i, 276; II, 1181  
 Inland waterways. *See* Canals and Waterways.  
 Inside routes. *See* Canals and Waterways.  
 Insley, Mary E. (schooner), removal of wreck of ..... i, 165, 971  
 Insular possessions:  
     Defense of ..... i, 8, 9, 14, 17  
     Improvement of Manila Harbor and Pasig River ..... i, 670; IV, 2903, 2910, 2911  
     Improvement of Pearl Harbor, Hawaii ..... i, 592; III, 2201



**Insular possessions—Continued.**

- Reconnaissances and explorations in, with technical features of engineer operations in the former department of North Philippines, and present department of Luzon..... i, 668, 669, 670; iv, 2478, 2908
- Service of officers of the Corps of Engineers abroad and in the field, with troops..... i, 24
- International Commission, Permanent, of Congresses of Navigation..... i, 639
- Ironton, Ohio:  
 Bridge across Ohio River to Ashland, Ky..... i, 644  
 Improvement of Ohio River..... i, 423; ii, 1627
- Island possessions. *See* Insular possessions.
- Isle of Wight Bay, Md., improvement of waterway via..... i, 180, 1002
- Isles of Shoals, Me., improvement of harbor at..... i, 55, 733
- Istokpoga Creek, Fla. (*see* Kissimmee River)..... i, 281; ii, 1193

**J.**

- Jackson, Ky., bridge across North Fork, Kentucky River..... i, 645
- Jackson, Lansing and Saginaw Railroad Company, bridge of..... i, 648
- Jacksonville, Fla.:  
*See also* St. Johns River.  
 Harbor lines in St. Johns River..... i, 640; ii, 1187
- James River, Va.:  
 Improvement of..... i, 216; ii, 1065  
 Protection of Jamestown Island..... i, 218; ii, 1071
- Jamestown Island, James River, Va., protection of..... i, 218; ii, 1071
- Jefferson, Tex., waterway to Shreveport, La. (*see* Cypress Bayou) ... i, 365; ii, 1372
- Jekyl Creek, Ga., improvement of waterway via..... i, 269; ii, 1166
- Jersey Central Traction Company, bridge of..... i, 650
- Johnsons Bayou, La., improvement of..... i, 343; ii, 1311
- Johnsons Creek or River, Conn. (*see* Bridgeport Harbor)..... i, 115, 846
- J street waterway, Whatcom, Wash., bridge across..... i, 645, 646
- Judith Point, R. I.:  
 Construction of harbor of refuge, with report on easterly detached breakwater..... i, 99, 807, 809  
 Improvement of pond entrance..... i, 100, 814
- Jupiter Inlet, Fla. (*see* Indian River)..... i, 277; ii, 1181
- Justice, Department of. *See* Attorney-General.

**K.**

- Kalamazoo River, Mich., improvement of..... i, 504; iii, 1945
- Kampsville lock and dam, Illinois River, Ill., operating and care ... i, 496; iii, 1917
- Kanawha River, W. Va.:  
 Improvement of..... i, 444; ii, 1721  
 Operating and care of locks and dams..... i, 445; ii, 1723
- Kansas City Southern Railway Company, bridge of..... i, 646
- Karquines Straits, Cal., channel to the Golden Gate (*see* San Pablo Bay)..... i, 583; iii, 2189
- Kenduskeag River, Me. (*see* Penobscot River)..... i, 43, 717
- Kennebec River, Me.:  
 Defenses of, including report on telephone booths and damp-proofing..... i, 9; iv, 2371  
 Improvement of..... i, 50, 724
- Kennebunk River, Me., improvement of..... i, 55
- Kennerdell, Pa., bridge across Allegheny River..... i, 647
- Kenosha Harbor, Wis., improvement of..... i, 487; ii, 1863
- Kentucky Lumber and Veneer Company, bridge of..... i, 645
- Kentucky, River, Ky.:  
 Bridge across North Fork below Jackson..... i, 645  
 Improvement of..... i, 450; ii, 1748  
 Operating and care of locks and dams..... i, 451; ii, 1753
- Keokuk, Iowa. *See* Mississippi River.
- Kerrs Run, Ohio, ice harbor in Ohio River..... i, 423; ii, 1627
- Kewaunee Harbor, Wis., improvement of..... i, 481; ii, 1848

- Keweenaw Bay, Mich.:**  
 Waterway to Lake Superior, improvement and care..... i, 471, 472; ii, 1815  
 Waterway to Lake Superior, removal of wreck ..... i, 475; ii, 1827  
**Keyport Harbor, N. J., improvement of** ..... i, 151, 939  
**Key West Harbor, Fla.:**  
 Defenses of, including report on damp-proofing ..... i, 9; iv, 2413  
 Improvement of, including dredge construction..... i, 278, 980; ii, 1183  
 Removal of wrecks ..... i, 281; ii, 1187  
**Kill van Kull, N. Y. and N. J.:**  
 Improvement of Staten Island-New Jersey channel ..... i, 148, 932  
 Recommendation for stone monuments to mark established harbor  
 lines along Staten Island ..... i, 141  
**Kingston Bay, Mass. (see Duxbury Harbor)** ..... i, 85, 781  
**Kingston, R. I.:**  
 Construction of Point Judith harbor of refuge, with report on easterly  
 detached breakwater..... i, 99, 807, 809  
 Improvement of entrance to Point Judith Pond..... i, 100, 814  
**Kingsville, S. C., bridge across Wateree River at** ..... i, 646  
**Kinnickinnick River, Wis. (see Milwaukee Harbor)** ..... i, 485; ii, 1857  
**Kissimmee Lake and River, Fla., improvement of** ..... i, 281; ii, 1193  
**Knox and Lincoln Branch, Maine Central Railroad Company, bridge across  
 Marsh River** ..... i, 649  
**Knoxville, Lafollette and Jellico Railroad Company, bridge of** ..... i, 644

## L.

- La Crosse Harbor, Wis., improvement of** ..... i, 396; ii, 1500  
**Laffrinier, Ira (schooner), removal of wreck of** ..... i, 88, 785  
**Lafourche Basin levee board of Louisiana, lock and dam in Bayou Lafourche.**  
*i, 641*  
**Lafourche Bayou, La.:**  
 Construction of lock and dam by the Atchafalaya Basin and Lafourche  
 Basin levee boards ..... i, 641  
 Improvement of ..... i, 330; ii, 1287  
**Lagrange Bayou, Fla., improvement of** ..... i, 298; ii, 1222  
**Lagrange lock and dam, Illinois River, Ill., operating and care** ..... i, 496; iii, 1917  
**Lakes, department of the, reconnaissances and explorations** ..... i, 668; iv, 2899  
**Lakes Ditch, Atlantic City, N. J., bridge across** ..... i, 648  
**Lakes, Great. See Great Lakes.**  
**Lake Washington Canal, Wash. See Puget Sound.**  
**Lamb, L. L. (barge), removal of wreck of** ..... i, 556; iii, 2106  
**Lambe, S. C., removal of wreck in Ashley River** ..... i, 257; ii, 1140  
**Lamprey River, N. H. (see Cochecho River)** ..... i, 56, 734  
**L'Anguille River, Ark., improvement of** ..... i, 387; ii, 1436  
**Larabee Landing, Lake Champlain, Vt., removal of wrecks near** ..... i, 73, 753  
**Larchmont Harbor, N. Y., improvement of** ..... i, 125, 860  
**La Trappe River, Md., improvement of** ..... i, 191, 1019  
**Lawrence Point, East River, N. Y., harbor lines** ..... i, 640, 891  
**Laws of 57th Congress, second session, affecting Corps of Engineers** ..... iv, 2943  
**Leaf River, Miss., improvement of** ..... i, 319; ii, 1260  
**Leakesville, Miss., bridge across Chickasahay River** ..... i, 645  
**Leavenworth, Fort, Kans.:**  
 Engineer depot at ..... i, 21, 23, 703  
 Engineer troops at ..... i, 5  
**Leech Lake, Minn.:**  
 Construction of reservoir dam ..... i, 398; ii, 1528  
 Operating and care of reservoir dam ..... i, 399; ii, 1538  
**Lee County, Fla., bridge of** ..... i, 647  
**Lee, Fort, N. J., harbor lines in Hudson River** ..... i, 640, 905  
**Lee Slough, Apalachicola River, Fla., improvement of** ..... i, 292; ii, 1212  
**Legislation of 57th Congress, second session, affecting Corps of Engineers** ..... iv, 2943  
**Leipsic River, Del., removal of wreck** ..... i, 194, 1025  
**Lemon Creek, N. Y. (see Staten Island-New Jersey channel)** ..... i, 148, 933  
**Leonardtown Harbor, Md. (see Breton Bay)** ..... i, 201; ii, 1044, 1045  
**Leon County, Fla., bridge of** ..... i, 649  
**Lemonds Cove, Rockland Harbor, Me., harbor lines** ..... i, 640, 727  
**Levels, water. See water-level observations.**

- Levisa Fork, Big Sandy River, Ky.:  
 Bridge near Whitehouse ..... i, 647  
 Improvement of ..... i, 448; ii, 1742
- Lewes, Del.:  
 Improvement of waterway to Chincoteague Bay, Va. .... i, 180, 1002  
 Iron pier in Delaware Bay near, maintenance and repair of ..... i, 163, 968
- Lewis and Clark River, Oreg., bridge across ..... i, 649
- Lewis River, Wash., improvement of ..... i, 618; iii, 2319
- Lichtenfels Bros. (barge), removal of wreck of ..... i, 145, 924
- Lincoln, Abraham, proposed monument to ..... i, 658; iv, 2565
- Lincoln County, W. Va., bridge of ..... i, 646
- Little Assawaman Bay, Del., waterway via ..... i, 180, 1002
- Little Calumet River, Ill., bridge at Chicago ..... i, 647
- Little Creek, Del., removal of wrecks ..... i, 194, 1023
- Little D'Arbonne Bayou, La. (*see* D'Arbonne Bayou) ..... i, 368, 370; ii, 1379
- Little Duck Creek (Leipaic River), Del., removal of wreck ..... i, 194, 1025
- Littlefalls, Minn., bridge of city of, across Mississippi River ..... i, 642
- Little Harbor, N. H., improvement of harbor of refuge ..... i, 58, 736
- Little Kanawha Railroad Company, bridges of ..... i, 650
- Little Kanawha River, W. Va.:  
 Bridge at Hyers Run ..... i, 649  
 Bridges in Wirt, Calhoun, Gilmer, and Braxton counties ..... i, 650  
 Improvement of ..... i, 443; ii, 1718  
 Operating and care of lock and dam ..... i, 444; ii, 1719
- Little Mud River, Ga., improvement of waterway via ..... i, 269; ii, 1166
- Little Myro (schooner), removal of wreck of ..... i, 194, 1024
- Little Narragansett Bay, R. I. and Conn. (*see* Pawcatuck River) ..... i, 104, 831
- Little Pedee River, S. C., improvement of ..... i, 244; ii, 1119
- Little Pigeon River, Tenn., improvement of ..... i, 421; ii, 1616
- Little River, Ark., bridge near White Cliffs ..... i, 646
- Little River, La. (part of Red River), improvement of ..... i, 361; ii, 1363
- Little River, La. (tributary of Red River), bridge near Simmons Ferry ..... i, 650
- Little Sarasota Bay, Fla., improvement of ..... i, 284; ii, 1197
- Little Sodus Bay, N. Y., improvement of harbor ..... i, 569; iii, 2157
- Little Tallahatchie River, Miss. (*see* Tallahatchie River) ..... i, 373; ii, 1396
- Livingston (schooner), removal of wreck of ..... i, 271; ii, 1171
- Lockport, Ill., survey for waterway to St. Louis, Mo. i, 494, 639; iii, 1904; S., 7, 68, 167
- Locks. *See* Canals and Waterways.
- Lockwood (steamer), removal of wreck of ..... i, 556; iii, 2106
- Lone Tree Point, Cal. (*see* San Pablo Bay) ..... i, 583; iii, 2189
- Long Bridge, Potomac River, Washington, D. C., highway bridge to replace ..... i, 643, 653; iv, 2484
- Long Island Sound, defenses of eastern entrance, including report on damp-proofing ..... i, 9; iv, 2387
- Long Sault Island, St. Lawrence River, N. Y., improvement at head of ..... i, 574; iii, 2168
- Long Tom River, Oreg., improvement of ..... i, 609; iii, 2257
- Lorain Harbor, Ohio:  
 Bridge across Black River ..... i, 645  
 Improvement of ..... i, 547; iii, 2066  
 Removal of wreck ..... i, 556; iii, 2104
- Louis Bayou, La., bridge across ..... i, 646
- Louisiana, State of:  
 Atchafalaya Basin and Lafourche Basin levee boards' lock and dam in Bayou Lafourche ..... i, 641  
 Removal of water hyacinths from waters in, including report on experiments made in the Florida district ..... i, 343; ii, 1312; iv, 2433  
 Rice Irrigation and Improvement Association's lock and dam in Mermentau River ..... i, 641
- Louisiana and Arkansas Railroad Company, bridge of ..... i, 650
- Louisiana Western Railroad, bridge across Calcasieu River, La. .... i, 648
- Louisville and Portland Canal, Ky.:  
 Enlargement of ..... i, 452; ii, 1763  
 Operating and care ..... i, 455; ii, 1765
- Loutre, Pass a, Mississippi River, La.:  
 Closing crevasse in ..... i, 324; ii, 1275  
 Constructing sill across ..... i, 325; ii, 1276

- Lower Machodoc Creek, Va., improvement of ..... i, 206; ii, 1055  
 Lubec channel, Me., improvement of ..... i, 37, 712  
 Ludington Harbor, Mich., improvement of ..... i, 514; iii, 1966  
 Luling, Chas. (schooner), removal of wreck of ..... iii, 2047  
 Lumberton Branch, Rancocas River, N. J., improvement of ..... i, 166, 984  
 Luzon, department of, reconnaissances and explorations, including technical details of engineer operations ..... i, 667, 669; iv, 2478, 2903  
 Lynn Harbor, Mass.:  
   Bridge across Saugus River to Revere ..... i, 650  
   Improvement of ..... i, 73, 759

## M.

- McClellan statue, Washington, D. C. .... i, 658; iv, 2517  
 McClellanville, S. C., improvement of waterway to Charleston, with estimates of cost ..... i, 252; ii, 1132  
 McKees Rocks, Pa., bridge across Ohio River to Allegheny ..... i, 644  
 Mackinac Straits, Mich., removal of wreck in ..... i, 542; iii, 2046  
 McKinley, Fort William, Manila Bay, P. I. .... iv, 2481, 2907  
 Maçon Bayou, La., improvement of ..... i, 368, 370; ii, 1379  
 Maine Central Railroad Company, bridge of ..... i, 649  
 Maine, defenses of coast, including report on telephone booths and damp-proofing ..... i, 9; iv, 2371  
 Main Ship channel, New York Harbor, N. Y.:  
   Improvement of ..... i, 139, 909  
   Removal of wrecks ..... i, 145, 924, 925  
 Malden River, Mass.:  
   Bridge between Everett and Melford ..... i, 650  
   Improvement of ..... i, 75, 761  
 Mall, the, Washington, D. C. .... i, 658; iv, 2517  
 Mamaroneck Harbor, N. Y., improvement of ..... i, 124, 859  
 Manasquan River, N. J., improvement of ..... i, 157, 953  
 Manatee River, Fla.:  
   Bridge at Craigs Point ..... i, 643  
   Improvement of ..... i, 287; ii, 1202  
 Manchac Bayou, La., improvement of ..... i, 338; ii, 1305  
 Manchac Pass, La., bridge in St. John the Baptist Parish ..... i, 645  
 Manchester Harbor, Mass., improvement of ..... i, 67, 745  
 Manila Bay and Harbor, P. I.:  
   Defenses of ..... i, 8, 9, 14, 17  
   Improvement of ..... i, 670; iv, 2903, 2910  
   Reconnaissances and explorations in the former department of North Philippines, and present department of Luzon, with technical details of engineer operations ..... i, 668, 669; iv, 2478, 2903  
 Manisces (U. S. steamer), removal of wrecks and other obstructions by ..... i, 145, 925  
 Manistee Harbor, Mich., improvement of ..... i, 516; iii, 1970  
 Manitowoc Harbor and River, Wis.:  
   Alleged shoal in Lake Michigan, south of ..... i, 665; iv, 2883  
   Improvement of ..... i, 482; ii, 1851  
   Survey of ..... i, 483; ii, 1880  
 Manokin River, Md., improvement of ..... i, 193, 1022  
 Manson, Agnes E. (schooner), removal of wreck of ..... i, 103, 820  
 Mantua Creek, N. J., improvement of ..... i, 168, 987  
 Maps:  
   Land within flats of Anacostia River, D. C. .... i, 36  
   Military and other ..... i, 667, 673; iv, 2478, 2899  
   Northern and Northwestern Lakes ..... i, 660, 665; iv, 2671  
 Marblehead Harbor, Mass.:  
   Repair of sea wall ..... i, 68, 747  
   Survey for breakwater ..... i, 69, 753  
 Matamoras, Pa., improvement of ice harbor ..... i, 166, 984  
 Matias Cito, Mich., removal of wreck near ..... iii, 2047  
 Menominee, Wis. (see Menominee River) ..... i, 475; ii, 1834  
 Marion County, W. Va., bridge of ..... i, 651  
 Marine Steam Passenger Railway Company, bridge of ..... i, 648

- Marquette Bay and Harbor, Mich.:  
 Construction of harbor of refuge in bay ..... I, 474; II, 1823  
 Improvement of harbor..... I, 473; II, 1820  
 Water levels..... I, 665; IV, 2678  
 Marriot (schooner), removal of wreck of ..... I, 103, 820  
 Marsh River, Me., bridge at Newcastle ..... I, 649  
 Marthas Vineyard, Mass., improvement of Vineyard Haven Harbor ..... I, 90, 791  
 Martin (schooner), removal of wreck of ..... III, 2047  
 Massachusetts, State of:  
 Bridge of, across Malden River between Everett and Medford..... I, 650  
 Bridge of, across Saugus River between Revere and Lynn..... I, 650  
 Matanzas River, Fla. (*see* St. Augustine Harbor) ..... I, 275; II, 1181  
 Matawan Creek, N. J., improvement of ..... I, 152, 841  
 Mathews, Dora (schooner), removal of wreck of ..... I, 103, 820  
 Mattaponi River, Va., improvement of ..... I, 214; II, 1063  
 Maumee Bay and River, Ohio:  
 Harbor lines in river at Toledo ..... I, 640; III, 2107  
 Improvement of Toledo Harbor, including dredge construction..... I, 542, 979; III, 2049  
 Removal of wreck in bay..... I, 557; III, 2106  
 May, Ida (canal boat), removal of wreck of ..... I, 194, 1023  
 Medford, Mass., bridge across Malden River to Everett..... I, 650  
 Meerwald, Mary W. (sloop), removal of wreck of ..... I, 165, 971  
 Memorials, statues, etc.:  
 In public grounds, Washington, D. C..... I, 658; IV, 2517  
 Memorial Bridge, Washington, D. C..... I, 653; IV, 2484  
 Monuments to Gens. Francis Nash and William Lee Davidson... I, 676; IV, 2939  
 Memphis Harbor, Tenn. (*see* Mississippi River Commission) ..... I, 639; S., 3, 40  
 Memphis, Helena and Louisiana Railway Company:  
 Bridge of, across St. Francis River, Ark..... I, 644  
 Bridges of, across White and Arkansas rivers, Ark ..... I, 643  
 Menekaunee, Wis. (*see* Menominee River) ..... I, 475; II, 1834  
 Menominee Harbor and River, Mich. and Wis., improvement of .... I, 475; II, 1834  
 Menominee River, Milwaukee, Wis.:  
 Bridges at West Water street ..... I, 649  
 Improvement of Milwaukee Harbor ..... I, 485; II, 1857  
 Mercer, Gen. Hugh, monument to ..... I, 658; IV, 2517  
 Mermentau River, La.:  
 Construction of lock and dam by the Rice Irrigation and Improvement Association ..... I, 641  
 Improvement of, including tributaries ..... I, 340; II, 1308  
 Merrimac River, Mass.:  
 Improvement of ..... I, 60, 738  
 Improvement of Newburyport Harbor ..... I, 59, 737  
 Methods, engineering, technical details of. *See* Technical details.  
 Metropolitan Park Commission of Massachusetts, bridge of..... I, 650  
 Metuchen, N. J., removal of wreck in Raritan River ..... I, 159, 955  
 Mexico, Gulf of:  
 Removal of water hyacinths from Florida tributaries, including report on experiments made ..... I, 279; II, 1184; IV, 2433  
 Removal of water hyacinths from Louisiana tributaries ..... I, 343; II, 1312  
 Removal of water hyacinths from Texas tributaries ..... I, 343  
 Miami Harbor and River, Fla.:  
 Bridge of Dade County at Avenue D..... I, 646  
 Bridge of Florida East Coast Railway Company ..... I, 648  
 Improvement of Biscayne Bay ..... I, 277; II, 1182  
 Mianus River, Conn., improvement of ..... I, 122, 854  
 Michigan Central Railroad Company:  
 Bridge of, across Indian River, Mich ..... I, 648  
 Bridge of, across Little Calumet River, Ill ..... I, 647  
 Michigan City, Ind.:  
 Improvement of inner harbor..... I, 498; III, 1931  
 Improvement of outer harbor..... I, 498, 499; III, 1931  
 Michigan Lake (*see also* Northern and Northwestern Lakes):  
 Alleged shoal south of Manitowoc Harbor, Wis..... I, 665; IV, 2883  
 Canal to Sturgeon Bay, improvement of, including harbor of refuge ..... I, 478; II, 1841

## Michigan Lake—Continued.

- Canal to Sturgeon Bay, operating and care ..... i, 480; ii, 1846
- Dredge boat for harbors on eastern shore ..... i, 498, 979
- Reef off Wind Point, near Racine Harbor, Wis. .... i, 665; iv, 2883
- Water levels ..... i, 665; iv, 2678
- Water levels on east shore, variations in ..... i, 498
- Michigan Lake Superior Power Company's canal at Sault Ste. Marie, Mich. . . i, 641
- Middle Island light-house, Lake Erie, removal of wreck ..... i, 556; iii, 2103
- Middle Neebish channel, St. Marys River, Mich., improvement of. . . i, 537; iii, 2027
- Middleport, Ohio, ice pier (*see* Ohio River) ..... i, 423; ii, 1627
- Milan, Ill.:
  - Construction of canal around Rock River at ..... i, 496; iii, 1920
  - Operating and care of canal around Rock River at ..... i, 395; ii, 1496
- Milford Harbor, Conn., improvement of ..... i, 112, 843
- Milford Haven, Va., improvement of harbor at ..... i, 213; ii, 1062
- Military reconnaissances and explorations, with report on technical features  
of engineer operations in the former department of North Philippines,  
and present department of Luzon ..... i, 667; iv, 2478, 2903
- Miller Bay, Lake Winnebago, Wis. (*see* Fox River) ..... i, 489; ii, 1866
- Mill River, New Haven, Conn., improvement of ..... i, 110, 839
- Mill River, Stamford, Conn. (*see* Stamford) ..... i, 120, 850
- Milwaukee Bay, Harbor, and River, Wis.:
  - Bridges across Menominee River at West Water street ..... i, 649
  - Improvement of ..... i, 485; ii, 1857
  - Water levels ..... i, 665; iv, 2678
- Mindanao, department of, reconnaissances and explorations ..... i, 667, 669; iv, 2903
- Miner, Bertha (barge), removal of wreck of ..... i, 139, 887
- Mines, submarine ..... i, 13, 15, 17
- Minim Creek-Estherville Canal, S. C. (*see* Santee River) ..... i, 248; ii, 1127
- Mining casemates ..... i, 13, 15, 17
- Mining, hydraulic, in California ..... i, 638; iii, 2367
- Minneapolis, Minn.:
  - See also* Mississippi River.
  - Bridge at Fifth avenue across slough at Boom Island, Mississippi River. . i, 650
- Minneapolis, Superior, St. Paul and Winnipeg Railway Company, bridge of. . i, 643
- Minnesota River, Minn.:
  - Improvement of ..... i, 401; ii, 1542
  - Survey of Big Stone Lake and Lake Traverse for reservoir dam. . . i, 404; ii, 1549
- Mispillion River, Del., improvement of ..... i, 178, 998
- Mission rock, San Francisco Harbor, Cal., harbor lines north of. . . i, 640; iii, 2202
- Mississippi River:
  - Anoka, Minn., bridge at ..... i, 643
  - Beechridge, Ill., prevention of break at ..... i, 392; ii, 1455
  - Boom Island, Minneapolis, Minn., bridge across slough at ..... i, 650
  - Brainerd to Grand Rapids, Minn., improvement from ..... i, 398; ii, 1528
  - Caruthersville, Mo. (*see* Mississippi River Commission) ..... i, 639; S., 3, 40
  - Delta Point, La. (*see* Mississippi River Commission) ..... i, 639; S., 3, 40
  - Des Moines Rapids Canal, examination for enlargement of locks, with  
estimates of cost, and for dam at foot of rapids. . . ii, 1500
  - Des Moines Rapids Canal and dry dock, operating and care ..... i, 395; ii, 1491
  - Dredge and snag boats above Missouri River, operation of. . . i, 393; ii, 1463
  - Dredge and snag boats below Missouri River, operation of. . . i, 389; ii, 1441
  - Dredge boats for outlet of ..... i, 325, 326, 973, 980
  - Gauging, including principal tributaries ..... i, 405, 639; ii, 1549; S., 7, 8, 62, 97
  - Grand Rapids to Brainerd, Minn., improvement from ..... i, 398; ii, 1528
  - Greenleaf Bend, Ill., prevention of break into Cache River. . . i, 392; ii, 1455
  - Greenville, Miss. (*see* Mississippi River Commission) ..... i, 639; S., 3, 40
  - Head of Passes to headwaters, surveys from ..... i, 639; S., 3, 40
  - Head of Passes to Ohio River, improvement, surveys, etc. . . i, 639; S., 3, 40
  - Helena, Ark. (*see* Mississippi River Commission) ..... i, 639; S., 3, 40
  - Hopefield Bend (*see* Mississippi River Commission) ..... i, 639; S., 3, 40
  - Illinois and Mississippi Canal, Ill., construction of ..... i, 496; iii, 1920
  - Illinois and Mississippi Canal, Ill., operating and care. . . i, 395; ii, 1496
  - La Crosse Harbor, Wis., improvement of ..... i, 396; ii, 1500
  - Littlefalls, Minn., bridge of city of ..... i, 642
  - Loutre, Pass a, La., closing crevasse in ..... i, 324; ii, 1275
  - Loutre, Pass a, La., constructing sill across ..... i, 325; ii, 1276
  - Memphis, Tenn. (*see* Mississippi River Commission) ..... i, 639; S., 3, 40
  - Minneapolis, Minn., bridge at Boom Island ..... i, 650

**Mississippi River—Continued.**

- Minneapolis, Minn., to St. Paul, improvement from..... i, 396; ii, 1523  
 Missouri River, above, operation of snag and dredge boats..... i, 393; ii, 1463  
 Missouri River, below, removal of snags and wrecks..... i, 389; ii, 1441  
 Missouri River to Ohio River, improvement from..... i, 390; ii, 1445  
 Missouri River to St. Paul, Minn., improvement from..... i, 393; ii, 1468  
 Natchez, Miss. (*see* Mississippi River Commission)..... i, 639; S., 3, 40  
 New Orleans, La., defenses of, including report on damp-proofing.. i, 9; iv, 2415  
 New Orleans, La., improvement at, by Mississippi River Commission..... i, 639; S., 3, 40  
 Ohio River to Head of Passes, improvement, surveys, etc..... i, 639; S., 3, 40  
 Ohio River to Missouri River, improvement from..... i, 390; ii, 1445  
 Outlet, improvement of..... i, 325, 973; ii, 1276  
 Pass a Loutre, La., closing crevasse in..... i, 324; ii, 1275  
 Pass a Loutre, La., constructing sill across..... i, 325; ii, 1276  
 Passes of, dredge boats for..... i, 325, 326, 973, 980; ii, 1276, 1277  
 Plaquemine Bayou, La., construction of lock..... i, 332; ii, 1289  
 Pokegama Falls, Minn., construction of reservoir dam..... i, 398; ii, 1528  
 Pokegama Falls, Minn., operating and care of reservoir dam..... i, 399; ii, 1538  
 Reservoir dams at headwaters, construction of..... i, 398; ii, 1528  
 Reservoir dams at headwaters, operating and care..... i, 399; ii, 1538  
 St. Louis, Mo., harbor lines..... i, 640; ii, 1455  
 St. Louis, Mo., to Lockport, Ill., survey for waterway..... i, 494, 639; iii, 1904; S., 7, 68, 167  
 St. Paul, Minn., gauging..... i, 405; ii, 1549  
 St. Paul, Minn., harbor lines..... i, 640; ii, 1513  
 St. Paul, Minn., to Minneapolis, improvement from..... i, 396; ii, 1523  
 St. Paul, Minn., to Missouri River, improvement from..... i, 393; ii, 1468  
 Snag and dredge boats above Missouri River, operation of\*..... i, 393; ii, 1463  
 Snags and wrecks below Missouri River, removal of..... i, 389; ii, 1441  
 South Pass, examinations and surveys..... i, 328; ii, 1278  
 South Pass, maintenance of channel..... i, 328; ii, 1279  
 Southwest Pass, improvement of, including dredge construction..... i, 326, 980; ii, 1277  
 Vicksburg Harbor, Miss., improvement of..... i, 370; ii, 1385  
 Vidalia, La. (*see* Mississippi River Commission)..... i, 639; S., 3, 40  
 Water-level observations on, including tributaries. i, 405, 639; ii, 1549; S., 7, 8, 62, 97  
 Wrecks, etc., above Missouri River, removal of..... i, 393; ii, 1463  
 Wrecks, etc., below Missouri River, removal of..... i, 389; ii, 1441
- Mississippi River Commission:**
- Improvement of Mississippi River..... i, 639; S., 3, 40  
 Survey for waterway from Lockport, Ill., to St. Louis, Mo..... i, 494, 639; iii, 1904; S., 7, 68, 167
- Mississippi Sound, Miss.:**
- Improvement of Gulfport-Ship Island Harbor channel..... i, 320; ii, 1266  
 Improvement of Horn Island Harbor..... i, 315; ii, 1258
- Missouri, department of the, reconnaissances and explorations ..** i, 668, 671; iv, 2914
- Missouri River:**
- Bridge between Cass County, Nebr., and Mills County, Iowa..... i, 644  
 Bridge between Council Bluffs, Iowa, and East Omaha, Nebr..... i, 642  
 Improvement of, with technical details concerning dike and revetment construction..... i, 405; ii, 1551; iv, 2437
- Mobile Harbor and River, Ala.:**
- Defenses of, including report on damp-proofing..... i, 9; iv, 2414  
 Improvement of..... i, 307; ii, 1237  
 Removal of sunken pontoons in river..... i, 324; ii, 1272
- Moccasin River (Contentnia Creek), N. C., improvement of.....** i, 232; ii, 1096
- Mokelumne River, Cal.:**
- Bridge near mouth of Snodgrass Slough..... i, 646  
 Improvement of..... i, 586; iii, 2193
- Monomoy Point, Mass., removal of wrecks off.....** i, 103, 819, 820
- Monongahela River, W. Va. and Pa.:**
- Bridge at Fairmont, W. Va..... i, 651  
 Harbor lines from Wilson to Elizabeth, at Hazelwood, and below Smithfield Street Bridge, Pittsburg, Pa..... i, 640; ii, 1698, 1702, 1706  
 Improvement at Locks 2, 3, and 6..... i, 429; ii, 1658  
 Improvement of, between Morgantown and Fairmont, W. Va... i, 427; ii, 1652

## Monongahela River, W. Va. and Pa.—Continued.

- Improvement of Pittsburgh Harbor ..... i, 432; ii, 1667
- Operating and care of locks and dams ..... i, 431; ii, 1660
- Monroe Harbor, Mich., improvement of ..... i, 528; iii, 1995
- Monroe Lake, St. Johns River, Fla. (*see* Volusia bar) ..... i, 274; ii, 1179
- Monuments, statues, etc.:
  - In public grounds, Washington, D. C. .... i, 658; iv, 2517
  - Memorial Bridge, Washington, D. C. .... i, 653; iv, 2484
  - To Gens. Francis Nash and William Lee Davidson ..... i, 676; iv, 2939
- Morgan Canal, Tex.:
  - Improvement of (*see* Galveston ship channel) ..... i, 351; ii, 1334
  - Operating and care ..... i, 353; ii, 1337
- Mormon channel, San Joaquin River, Cal.:
  - Bridge at Stockton ..... i, 648
  - Improvement of ..... i, 584, 585; iii, 2190, 2193
- Mortar batteries ..... i, 9, 14, 17
- Mosher, Amorette (schooner), removal of wreck of ..... i, 556; iii, 2105
- Mosquito Creek Canal, S. C. (*see* Santee River) ..... i, 248; ii, 1127
- Mound City, Ill. (*see* Ohio River) ..... i, 423; ii, 1627
- Mount Desert, Bar Harbor, Me., construction of breakwater ..... i, 39, 714
- Mount Holly Branch, Rancocas River, N. J., improvement of ..... i, 166, 984
- Mount Hope Bay, Mass. (*see* Fall River Harbor) ..... i, 97, 803
- Mount Pleasant shore, Charleston, S. C., improvement at ..... i, 253; ii, 1134
- Mount Rainier National Park, Wash., survey for road ..... i, 37
- Mud Lake, La. (*see* Mermentau River) ..... i, 340; ii, 1308
- Mud River, Ga., improvement of waterway via ..... i, 269; ii, 1166
- Mud River, S. C. (*see* Savannah-Beaufort waterway) ..... i, 257; ii, 1141
- Murderkill River, Del., improvement of ..... i, 176, 996
- Muscle Shoals Canal, Tennessee River, Ala.:
  - Construction of ..... i, 417; ii, 1594
  - Operating and care ..... i, 419; ii, 1605
- Muskegon Harbor, Mich., improvement of ..... i, 510; iii, 1958
- Muskingum River, Ohio:
  - Improvement of ..... i, 446; ii, 1731
  - Operating and care of locks and dams ..... i, 447; ii, 1732
- Myro, Little (schooner), removal of wreck of ..... i, 194, 1024
- Mystic River, Mass.:
  - Improvement of ..... i, 75, 761
  - Improvement of, below mouth of Island End River ..... i, 76, 763

## N.

- Nandua Creek, Va., improvement of ..... i, 207; ii, 1054
- Nansemond River, Va., improvement of ..... i, 222; ii, 1078
- Nanticoke River, Del. and Md., improvement of ..... i, 192, 1021
- Nantucket, Mass., construction of harbor of refuge at ..... i, 89, 790
- Nantucket Sound, Mass., removal of wrecks ..... i, 103, 819, 820
- Napa River, Cal., improvement of ..... i, 590; iii, 2198
- Narragansett Bay, R. I.:
  - Defenses of, including report on foundations, damp-proofing, and painting of concrete ..... i, 9; iv, 2384
  - Improvement of ..... i, 95, 801
- Narraguagus River, Me., improvement of ..... i, 38, 713
- Narrows of Lake Champlain, N. Y. and Vt.:
  - Improvement of ..... i, 72, 752
  - Removal of wrecks ..... i, 73, 753
- Nasel River, Wash. (*see* Willapa River) ..... i, 620; iii, 2323
- Nash, Gen. Francis, monument to ..... i, 676; iv, 2939
- Nashville Terminal Company, bridge of ..... i, 643
- Natalbanv River, La. (*see* Tickfaw River) ..... i, 338; ii, 1303
- Natchez Bay, La. (*see* Bayou Plaquemine) ..... i, 332; ii, 1289, 1312
- Natchez Harbor, Miss. (*see* Mississippi River Commission) ..... i, 639; S., 3, 40
- National parks. *See* Parks.
- Nauset Harbor, Mass., removal of wreck ..... i, 88, 785
- Navesink River, N. J. (*see* Shrewsbury River) ..... i, 155, 950
- Navigable waters. *See* Bridges, Rivers and harbors, and Wrecks.
- Navigation, Congresses of, Permanent International Commission ..... i, 639
- Neches River, Tex., improvement of ..... i, 344; ii, 1314
- Neebish channels, St. Marys River, Mich., improvement of ..... i, 537; iii, 2027



- Negro Out, Indian River Inlet, Fla. (*see* Indian River)..... i, 276; ii, 1181  
 Neshaminy Creek, Pa., bridge near Croydon..... i, 646  
 Nettie (sloop), removal of wreck of..... i, 194, 1023  
 Neuse River, N. C.:  
   Improvement of..... i, 223; ii, 1097  
   Improvement of waterway between Newbern and Beaufort..... i, 235; ii, 1101  
 Newark, N. J.:  
   Improvement of Passaic River..... i, 145, 927  
   Removal of wreck in Passaic River..... i, 159, 955  
 Newark Bay, N. J.:  
   Improvement of (*see* Arthur Kill)..... i, 148, 932  
   Improvement of (*see* Passaic River)..... i, 145, 927  
   Removal of wrecks..... i, 158, 159, 954, 955  
 New Bedford Harbor, Mass.:  
   Defenses of..... i, 9  
   Harbor lines..... i, 640, 820  
   Improvement of..... i, 92, 794  
 Newbern, N. C.:  
   Harbor lines in Trent River..... i, 640; ii, 1114  
   Improvement of Neuse River..... i, 233; ii, 1097  
   Improvement of Trent River..... i, 234; ii, 1099  
   Improvement of waterway to Beaufort, N. C..... i, 235; ii, 1101  
 Newburgh and South Shore Railway Company, bridge of..... i, 650  
 Newburyport Harbor, Mass., improvement of..... i, 59, 737  
 Newcastle, Me., bridge across Marsh River..... i, 649  
 New Haven Harbor, Conn.:  
   Bridge across West River at Kimberly avenue..... i, 651  
   Construction of breakwaters..... i, 112, 842  
   Improvement of, by dredging..... i, 110, 839  
 New Jersey-Staten Island channel:  
   Improvement of..... i, 147, 932  
   Removal of wrecks in Arthur Kill..... i, 158, 159, 955, 956  
 New London Harbor, Conn.:  
   Bridge across Smiths Cove, Thames River..... i, 652  
   Improvement of..... i, 105, 833  
 New London Northern Railroad Company, bridge of..... i, 652  
 New Orleans Harbor, La.:  
   Defenses of, including report on damp-proofing..... i, 9; iv, 2415  
   Improvement of (*see* Mississippi River Commission)..... i, 639; S., 3, 40  
 Newport Bridge, Belt and Terminal Railway Company, bridge of..... i, 642  
 Newport Harbor, Ark., bridge across White River..... i, 642  
 Newport Harbor, R. I., improvement of..... i, 98, 805  
 Newport News Point, Hampton Roads, Va., removal of wreck..... i, 228; ii, 1088  
 Newport River, N. C.:  
   Improvement of Beaufort Harbor..... i, 236; ii, 1102  
   Improvement of waterway between Beaufort and New River..... i, 236; ii, 1103  
   Improvement of waterway between Newbern and Beaufort..... i, 235; ii, 1101  
 New River, N. C.:  
   Improvement of..... i, 237; ii, 1104  
   Improvement of waterway to Beaufort..... i, 236; ii, 1103  
 New Rochelle, N. Y. (*see* Echo Bay Harbor)..... i, 126, 861  
 New Shoreham, Block Island, R. I.:  
   Construction of harbor of refuge..... i, 101, 815  
   Improvement of Great Salt Pond..... i, 102, 817  
 Newtown Creek, N. Y.:  
   Harbor lines in east branch at Brooklyn..... i, 640, 898  
   Improvement of..... i, 133, 873  
 New Whatcom Harbor, Wash.:  
   Bridge across I and J streets waterway..... i, 645, 646  
   Bridge across Whatcom Creek waterway..... i, 647  
   Improvement of..... i, 634; iii, 2337  
 New York, Chicago and St. Louis Railroad Company:  
   Bridge of, across Black River, Ohio..... i, 645  
   Bridge of, across Calumet River, Ill..... i, 643, 644  
 New York City and Harbor, N. Y.:  
   Ambrose channel, improvement of, including dredge construction..... i, 139, 909, 979  
   Arthur Kill, improvement of..... i, 147, 932

## New York City and Harbor, N. Y.—Continued.

Arthur Kill, recommendation for stone monuments to mark established harbor lines .....	i, 141
Arthur Kill, removal of wrecks .....	i, 158, 159, 955, 956
Battery, the, removal of shoal off Pier A .....	i, 140, 911
Bay Ridge channel, improvement of .....	i, 142, 915
Bayside channel, improvement of .....	i, 139, 909
Berrian Island, East River, harbor lines .....	i, 640, 891
Bronx River, improvement of .....	i, 126, 862
Bronx River, removal of wrecks .....	i, 138, 139, 887
Buttermilk channel, improvement of .....	i, 143, 917
Buttermilk channel, removal of obstruction .....	i, 145, 925
Defenses of, including report on damp-proofing .....	i, 9, 14, 16; iv, 2390
East (Ambrose) channel, improvement of .....	i, 139, 909, 979
East Chester Bay, bridge in Pelham Bay Park .....	i, 650
East Chester Creek, improvement of .....	i, 126, 864
East River, harbor lines at North Brother Island, Lawrence Point, and Berrian Island, and between East Thirteenth and East Eighteenth streets .....	i, 640, 888, 891, 895
East River, improvement of .....	i, 131, 871
East River, removal of wreck .....	i, 139, 887
Engineer depot .....	i, 21, 23, 705
Flushing Bay, improvement of .....	i, 129, 868
Fort Lee, N. J., harbor lines in Hudson River to Guttenberg .....	i, 640, 905
Fort Totten, building for School of Submarine Defense .....	i, 13, 16
Gedney channel, improvement of .....	i, 139, 909
Governors Island, enlargement of .....	i, 144, 920
Gowanus Bay and Canal, improvement of .....	i, 142, 915
Gowanus Creek, removal of wreck .....	i, 145, 924
Gowanus Creek channel, improvement of .....	i, 143, 919
Harlem River, improvement of .....	i, 132, 872
Hell Gate, East River, improvement of .....	i, 131, 871
Hoffman Island, removal of wreck .....	i, 145, 925
Hudson River, harbor lines from Fort Lee to Guttenberg, N. J. ....	i, 640, 905
Hudson River, removal of wreck near Hoboken, N. J. ....	i, 139, 887
Hudson River, removal of reef off Pier A, North River .....	i, 140, 911
Improvement of, including dredge construction .....	i, 139, 909, 979
Kill van Kull, improvement of Staten Island-New Jersey channel ...	i, 148, 932
Kill van Kull, recommendation for stone monuments to mark established harbor lines along Staten Island .....	i, 141
Lawrence Point, East River, harbor lines .....	i, 640, 891
Lee, Fort, N. J., harbor lines in Hudson River to Guttenberg .....	i, 640, 905
Lemon Creek ( <i>see</i> Staten Island-New Jersey channel) .....	i, 148, 933
Main Ship channel, improvement of .....	i, 139, 909
Main Ship channel, removal of wrecks .....	i, 145, 924, 925
Newark Bay, improvement of ( <i>see</i> Passaic River) .....	i, 145, 927
New Jersey-Staten Island channel, improvement of .....	i, 148, 932
Newtown Creek, harbor lines in east branch, at Brooklyn .....	i, 640, 898
Newtown Creek, improvement of .....	i, 133, 873
North Brother Island, East River, harbor lines .....	i, 640, 888
North (Hudson) River, harbor lines from Fort Lee to Guttenberg, N. J. ....	i, 640, 905
North (Hudson) River, removal of reef off Pier A .....	i, 140, 911
North (Hudson) River, removal of wrecks .....	i, 139, 887
Pelham Bay Park, bridge across East Chester Bay .....	i, 650
Red Hook channel, improvement of .....	i, 142, 915
Southwest Spit, removal of obstructions .....	i, 145, 925
Spyten Duyvil Creek ( <i>see</i> Harlem River) .....	i, 132, 872
Staten Island-New Jersey channel, improvement of .....	i, 148, 932
Staten Island Sound (Arthur Kill), improvement of .....	i, 147, 932
Staten Island Sound (Arthur Kill), removal of wrecks .....	i, 158, 159, 955, 956
Staten Island water front, recommendation for stone monuments to mark established harbor lines .....	i, 141
Supervision of .....	i, 637; iii, 2359
Tompkinsville, removal of wreck off .....	i, 145, 924
Totten, Fort, building for School of Submarine Defense .....	i, 13, 16
Niagara River, N. Y.:	
Buffalo Harbor, improvement of .....	i, 559; iii, 2126
Erie Basin and Black Rock Harbor, improvement of Buffalo entrance .....	i, 562; iii, 2143

**Niagara River, N. Y.—Continued.**

- Erie Basin and Black Rock Harbor, improvement of Lake Erie entrance ..... i, 562; iii, 2142
- North Tonawanda to Lake Erie, including Tonawanda Harbor, improvement from ..... i, 563; iii, 2144
- Surveys, etc. (*see* Northern and Northwestern Lakes) ..... i, 660; iv, 2671
- Nomini Creek, Va., improvement of ..... i, 209; ii, 1057
- Nooksak River, Wash. (*see* Puget Sound) ..... i, 625; iii, 2328
- Norfolk Harbor, Va.:
  - Harbor lines in Smith Creek and Elizabeth River ..... i, 640; ii, 1089
  - Defenses of Hampton Roads ..... i, 14
  - Improvement of, and its approaches, including Hospital Point .. i, 219; ii, 1074
  - Improvement of waterway to Albemarle Sound, via Currituck Sound ..... i, 226; ii, 1084
  - Improvement of waterway to sounds of North Carolina, via Pasquotank River ..... i, 225; ii, 1083
  - Improvement of Western Branch, Elizabeth River ..... i, 220; ii, 1076
- North Branch, Chicago River, Ill. *See* Chicago Harbor and River.
- North Brother Island, East River, N. Y., harbor lines ..... i, 640, 888
- North Carolina Cut, N. C., improvement of waterway via ..... i, 226; ii, 1084
- North Carolina, State of:
  - Defenses of coast, including report on damp-proofing and on use of paint made of coal tar and kerosene oil ..... i, 9; iv, 2408
  - Improvement of waterways from Norfolk, Va., to sounds of ..... i, 225, 226; ii, 1083, 1084
- North Coeymans, N. Y., removal of wreck in Hudson River ..... i, 139, 888
- Northeast River, N. C., improvement of ..... i, 238; ii, 1105
- Northern and Northwestern Lakes:
  - Commercial statistics, Sault Ste. Marie canals, Mich. .... i, 535; iii, 2010, 2015
  - Dredge boat for harbors on Lake Erie. *See* Dredge boats, etc.
  - Dredge boat for harbors on eastern shore of Lake Michigan ..... i, 498, 979
  - Defenses of ..... i, 8, 9
  - Improvement of channels in waters connecting ..... i, 532; iii, 2001
  - Outflow, rainfall, and evaporation in valley of ..... i, 665; iv, 2855
  - Survey of waters connecting lakes Superior and Huron, final report on .. i, 542
  - Surveys and charts, with complete list of permanent and temporary bench marks ..... i, 660, 665; iv, 2671, 2693
  - Water levels ..... i, 665; iv, 2678
  - Water levels on east shore of Lake Michigan, variations in ..... i, 498
- Northern Pacific Railway Company:
  - Bridge of, across Deschutes River, Wash. .... i, 645
  - Bridge of, across Humptulips River, Wash. .... i, 651
  - Bridge of, across Lake Pend Oreille, Idaho ..... i, 646
  - Bridge of, across right of way of Lake Washington Canal, Wash. .... i, 645
- North Fork, Kentucky River, Ky., bridge below Jackson ..... i, 645
- North Fork, Skagit River, Wash. (*see* Puget Sound) ..... i, 625; iii, 2328
- North Hero Island channel, Lake Champlain, Vt., improvement of ..... i, 69
- North Landing River, Va. and N. C., improvement of waterway via .. i, 226; ii, 1084
- North Philippines, department of, reconnaissances and explorations, including technical features of engineer operations ..... i, 666, 669; iv, 2478, 2903
- North (Hudson) River, N. Y. *See* New York City and Harbor.
- North (Tolomato) River, Fla. (*see* St. Augustine Harbor) ..... i, 275; ii, 1181
- North River, N. C.:
  - Improvement of waterway via ..... i, 226; ii, 1084
  - Removal of wreck ..... i, 228; ii, 1088
- North River, Wash. (*see* Willapa River) ..... i, 620; iii, 2323
- North Tonawanda, N. Y. (*see* Tonawanda) ..... i, 563; iii, 2144
- Norwalk Harbor, Conn., improvement of ..... i, 118, 849

**O.**

- Oak Creek, Wis. (*see* South Milwaukee Harbor) ..... i, 486; ii, 1860
- Oakdene (steamer), removal of wreck ..... i, 194, 1024
- Oakland Harbor, Cal.:
  - Bridge across San Leandro Bay between Alameda and Bay Farm Island. i, 646
  - Defenses of San Francisco, including report on construction methods, damp-proofing, and transportation of ordnance ..... i, 9; iv, 2417
  - Improvement of ..... i, 582; iii, 2186

- Oak Orchard Harbor, N. Y., improvement of..... i, 566; iii, 2149
- Obion River, Tenn.:  
     Bridge near Burnt Mills ..... i, 646  
     Improvement of ..... i, 410; ii, 1579
- Ocoquan Creek, Va., improvement of ..... i, 205; ii, 1051
- Ocklawaha (Oklawaha) River, Fla., improvement of ..... i, 275; ii, 1180
- Ocklockonee River, Fla.:  
     Bridge in Leon County ..... i, 649  
     Bridge near Sopchoppy ..... i, 652
- Ocmulgee River, Ga., improvement of ..... i, 266; ii, 1161
- Oconee River, Ga., improvement of ..... i, 265; ii, 1160
- Oconto Harbor, Wis., improvement of, including report on project by the  
     Board of Engineers for Rivers and Harbors ..... i, 476; ii, 1835, 1836
- Ocracoke Inlet, N. C., improvement of ..... i, 229; ii, 1093
- Office of the Chief of Engineers, officers on duty in ..... i, 676
- Officers, engineer, civilian assistants to ..... i, 23
- Officers of the Corps of Engineers. *See* Corps of Engineers.
- Ogdensburg Harbor, N. Y., improvement of ..... i, 573; iii, 2165
- Ohio River:  
     Bridge between Allegheny and borough of McKees Rocks, Pa. .... i, 644  
     Bridge between Ironton, Ohio, and Ashland, Ky. .... i, 644  
     Bridge between Steubenville, Ohio, and Cross Creek Township, W. Va. .... i, 644  
     Bridges impeding navigation, report upon ..... i, 37  
     Falls at Louisville, Ky., improvement of ..... i, 452; ii, 1763  
     Gauging (*see* Mississippi River Commission) ..... i, 639; S., 7, 8, 62, 97  
     General improvement from Pittsburg to the mouth ..... i, 423; ii, 1627  
     Ice piers ..... i, 423; ii, 1627  
     Indiana Chute, Louisville, Ky., improvement of ..... i, 452; ii, 1763  
     Lock and Dam 1, at Davis Island, Pa., operating and care ..... i, 435; ii, 1671  
     Locks and Dams 2-7, construction of ..... i, 435; ii, 1672  
     Locks and Dams 8, 11, 13, 18, 19, construction of ..... i, 441; ii, 1713  
     Lock and Dam 37, construction of ..... i, 426; ii, 1645  
     Louisville and Portland Canal, Ky., enlargement of ..... i, 452; ii, 1763  
     Louisville and Portland Canal, Ky., operating and care ..... i, 455; ii, 1765  
     Pittsburg Harbor, Pa., improvement of ..... i, 432; ii, 1667  
     Pittsburg Harbor, Pa., Davis Island pool (No. 1), survey for increased  
         depth and additional harbor facilities ..... i, 434; ii, 1688  
     Snag boat, operation of ..... i, 426; ii, 1647
- Okanogan River, Wash., improvement of ..... i, 635; iii, 2338
- Oklawaha River, Fla., improvement of ..... i, 275; ii, 1180
- Olcott Harbor, N. Y., improvement of ..... i, 566; iii, 2151
- Old Tampa Bay, Fla. (*see* Tampa Bay) ..... i, 284; ii, 1198
- Olympia Harbor, Wash.:  
     Bridge across Deschutes River ..... i, 645  
     Improvement of ..... i, 626; iii, 2330
- Omaha Bridge and Terminal Railway Company, bridge of ..... i, 642
- Omaha (East), Nebr., bridge across Missouri River to Council Bluffs, Iowa. .... i, 642
- Ontario Lake (*see also* Northern and Northwestern Lakes):  
     Removal of wreck off Braddock Point light station ..... i, 575; iii, 2169  
     Water levels ..... i, 665; iv, 2678
- Ontonagon Harbor, Mich., improvement of ..... i, 470; ii, 1813
- Oostenaula River, Ga., improvement of ..... i, 303, 305; ii, 1233
- Orange, Conn., Kimberly avenue bridge across West River to New Haven. .... i, 651
- Orange Mills flats, St. Johns River, Fla.:  
     Improvement at and near ..... i, 273; ii, 1178  
     Removal of water hyacinths in vicinity of, including report on experi-  
         ments made ..... i, 279; ii, 1184; iv, 2433
- Orange River, Fla., improvement of ..... i, 282; ii, 1194
- Ordnance. *See* Fortifications.
- Ordway rifle range ..... i, 17, 666
- Osage River, Mo., improvement of ..... i, 408; ii, 1568
- Oshkosh, Wis.:  
     Bridge across Fox River ..... i, 645  
     Harbor lines in Fox River ..... i, 640; ii, 1884  
     Improvement of Fox River ..... i, 489; ii, 1866
- Oswegatchie River, N. Y. (*see* Ogdensburg Harbor) ..... i, 573; iii, 2165

- Oswego Harbor, N. Y., improvement of ..... I, 570; III, 2160  
 Otter Creek, Vt., improvement of ..... I, 71, 750  
 Otter Tail Lake and River, Minn., survey of ..... I, 404; II, 1548  
 Ouachita River, Ark. and La.:  
     Bridge between Ashley and Union counties, Ark ..... I, 643  
     Improvement of ..... I, 366; II, 1373  
 Outflow, rainfall, and evaporation in valley of Northern and Northwestern  
     Lakes ..... I, 665; IV, 2855  
 Ozark and Cherokee Central Railway Company, bridge of ..... I, 642

## P.

- Pacific County, Wash., bridge of ..... I, 647  
 Pagan River, Va., improvement of ..... I, 222; II, 1079  
 Pamlico County, N. C., bridge of ..... I, 652  
 Pamlico River, N. C., improvement of ..... I, 231; II, 1094  
 Pamlico Sound, N. C., improvement of waterway to Norfolk, Va ..... I, 225; II, 1083  
 Pamunkey River, Va., improvement of ..... I, 215; II, 1064  
 Parks, public:  
     District of Columbia, improvement and care ..... I, 658; IV, 2517  
     Mount Rainier National Park, Wash., survey for road ..... I, 37  
     Yellowstone National Park, improvement, etc., with report giving  
         technical details ..... I, 666; IV, 2444, 2885  
 Pascagoula River, Miss.:  
     Improvement above mouth of Dog River ..... I, 317; II, 1260  
     Improvement below mouth of Dog River ..... I, 315; II, 1258  
 Pasig River, Philippine Islands, improvement of ..... I, 670; IV, 2903, 2911  
 Pasquotank River, N. C.:  
     Improvement of waterway via ..... I, 225; II, 1083  
     Removal of cribs of logs ..... I, 228; II, 1088  
 Passaic, N. J.:  
     Improvement of Passaic River ..... I, 145, 927  
     Removal of wreck in Passaic River ..... I, 158, 954  
 Passaic Bridge, N. J., removal of wreck in Passaic River ..... I, 158, 954  
 Passaic light-house, Newark Bay, N. J., removal of wreck ..... I, 159, 955  
 Passaic River, N. J.:  
     Improvement of ..... I, 145, 927  
     Removal of wrecks ..... I, 158, 159, 954, 955  
 Pass a Loutre, Mississippi River, La.:  
     Closing crevasse in ..... I, 324; II, 1275  
     Constructing sill across ..... I, 325; II, 1276  
 Pass Manchac, La., bridge in St. John the Baptist Parish ..... I, 645  
 Patapsco River, Md.:  
     Bridge at Spring Garden, Baltimore ..... I, 649  
     Defenses of Baltimore, including report on damp-proofing ..... I, 9; IV, 2400  
     Harbor lines at Sparrow Point ..... I, 640; II, 1033  
     Improvement of, and channel to Baltimore ..... I, 194; II, 1027  
     Improvement of channel to Curtis Bay ..... I, 196; II, 1031  
     Improvement of harbor at southwest Baltimore (Spring Garden) ..... I, 197; II, 1031  
     Revised estimate of cost of increasing depth of channel to Baltimore ..... I, 195; II, 1032  
 Patchogue River, N. Y., improvement of (*see* Great South Bay) ..... I, 134, 875  
 Patcong Creek, N. J., bridge at Steelmanville ..... I, 651  
 Patuxent River, Md., improvement of, including report on project by the  
     Board of Engineers for Rivers and Harbors ..... I, 203; II, 1047, 1048  
 Pawcatuck River, R. I. and Conn., improvement of ..... I, 104, 831  
 Pawpaw River, Mich. (*see* St. Joseph Harbor) ..... I, 501; III, 1937  
 Pawtucket (Seekonk) River, R. I.:  
     Harbor lines at Providence ..... I, 640, 825  
     Improvement of ..... I, 95, 799  
 Peace Creek, Fla. (*see* Charlotte Harbor) ..... I, 282; II, 1194  
 Pearl Harbor, Hawaii:  
     Defenses of ..... I, 8, 9, 14, 17  
     Improvement of ..... I, 592; III, 2201  
 Pearl River, Miss.:  
     Improvement between Edinburg and Jackson ..... I, 323; II, 1270  
     Improvement below Rockport ..... I, 322; II, 1269

## Pedee rivers, S. C.:

- Improvement of Little Pedee ..... i, 244; ii, 1119
- Improvement of Great Pedee ..... i, 245; ii, 1120
- Peekskill Harbor, N. Y., improvement of ..... i, 137, 885
- Pelham Bay Park, N. Y., bridge across East Chester Bay ..... i, 650
- Pell (sloop), removal of wreck of ..... i, 139, 887
- Pender County, N. C., bridge of ..... i, 648
- Pend Oreille Lake, Idaho, bridge across ..... i, 646
- Pend Oreille River, Wash., improvement of ..... i, 635; iii, 2338
- Pennsylvania Railroad Company:
  - Bridge of ..... i, 649
  - Bridge of Philadelphia, Baltimore and Washington Railroad Company. i, 649, 650
- Penobscot River, Me.:
  - Defenses of, including report on telephone booths and damp-proofing. .... i, 9; iv, 2371
  - Improvement of ..... i, 43, 717
  - Improvement of Bucksport Harbor ..... i, 45, 719
- Pensacola Harbor, Fla.:
  - Defenses of, including report on damp-proofing ..... i, 9, 12; iv, 2413
  - Improvement of, including dredge construction ..... i, 299, 977; ii, 1223
- Pentwater Harbor, Mich., improvement of ..... i, 512; iii, 1962
- Pequonnock River, Conn. (*see* Bridgeport Harbor) ..... i, 115, 846
- Pere Marquette Lake, Mich. (*see* Ludington Harbor) ..... i, 514; iii, 1966
- Permanent International Commission of Congresses of Navigation ..... i, 639
- Petaluma Creek, Cal., improvement of ..... i, 589; iii, 2197
- Petersburg, Va., diversion of Appomattox River at ..... i, 224; ii, 1080
- Petoskey Harbor, Mich., improvement of ..... i, 521; iii, 1981
- Philadelphia, Pa.:
  - Bridge across Schuylkill River at Market street ..... i, 648
  - Defenses of Delaware River ..... i, 9
  - Improvement of Delaware River at ..... i, 159, 957, 960
  - Removal of wreck in Delaware River at ..... i, 165, 971
  - Removal of wreck in Schuylkill River at ..... i, 194, 1024
- Philadelphia, Baltimore and Washington Railroad Company, bridge of... i, 649, 650
- Philadelphia, Bristol and Trenton Street Railway Company, bridge of.... i, 646
- Philippine Islands:
  - Defenses of ..... i, 8, 9
  - Improvement of Manila Harbor and Pasig River..... i, 670; iv, 2903, 2910, 2911
  - Reconnaissances and explorations in, with technical features of engineer operations in the former department of North Philippines, and present department of Luzon ..... i, 668, 669; iv, 2478, 2903
  - Service of officers of the Corps of Engineers abroad and in the field, with troops ..... i, 24
- Philippines (North), department of, reconnaissances and explorations, including technical features of engineer operations ..... i, 666, 669; iv, 2478, 2903
- Phillips, W. K. (steamer), removal of wreck of ..... i, 417; ii, 1589
- Pierhead lines. *See* Harbor lines.
- Pierre, S. Dak. (*see* Missouri River) ..... i, 405; ii, 1551
- Pierre, Fort, S. Dak. (*see* Missouri River) ..... i, 405; ii, 1551
- Pigeon Bayous, La., improvement of ..... i, 332; ii, 1289
- Pike Creek, Wis. (*see* Kenosha Harbor) ..... i, 487; ii, 1863
- Pine Island Sound, Fla. (*see* Charlotte Harbor) ..... i, 282; ii, 1194
- Pine Lake and River (Charlevoix County), Mich. (*see* Charlevoix Harbor) ..... i, 519; iii, 1978
- Pine River (St. Clair County), Mich., improvement of ..... i, 530; iii, 1997
- Pine River, Minn.:
  - Construction of reservoir dam ..... i, 398; ii, 1528
  - Operating and care of reservoir dam ..... i, 399; ii, 1538
- Pineville, La.:
  - Bridge across Red River to Alexandria (Alexandria and Pineville Bridge Company) ..... i, 644
  - Bridge across Red River to Alexandria (Shreveport and Red River Valley Railway Company) ..... i, 643
- Pinole, Point, Cal. (*see* San Pablo Bay) ..... i, 583; iii, 2189
- Pittsburg Harbor, Pa.:
  - See also* Allegheny, Monongahela, and Ohio rivers.
  - Bridge across Allegheny River, to Allegheny (Union Bridge) ..... i, 651

Pittsburg Harbor, Pa.—Continued.

- Bridge across Allegheny River at Brilliant Station ..... i, 649
- Bridge across Allegheny River at Herr Island ..... i, 649
- Harbor lines in Monongahela and Allegheny rivers... i, 640; ii, 1702, 1706, 1709
- Improvement of ..... i, 432; ii, 1667
- Survey of Davis Island pool (No. 1), Ohio River, for increased depth  
and additional harbor facilities ..... i, 434; ii, 1688
- Plantz, Laura E. (canal boat), removal of wreck of ..... i, 159, 955
- Plaquemine Bayou, La.:
  - Improvement of ..... i, 332; ii, 1289
  - Removal of water hyacinths, including report on experiments made in  
the Florida district ..... i, 343; ii, 1312; iv, 2433
- Plattsburg Harbor, N. Y., improvement of ..... i, 72, 751
- Plattsmouth Pontoon Bridge Company, bridge of ..... i, 644
- Pleasant, Point, Me., bridge to Carlows Island ..... i, 652
- Pleasantville and Atlantic Turnpike or Plank Road Company, bridge of... i, 647
- Plymouth Harbor, Mass., improvement of ..... i, 86, 782
- Pocomoke River, Md., improvement of ..... i, 189, 1015
- Poge, Cape, light-house, Mass., removal of wreck ..... i, 103, 819
- Point Judith Harbor and Pond, R. I.:
  - Construction of harbor of refuge, with report on easterly detached  
breakwater ..... i, 99, 807, 809
  - Improvement of pond entrance ..... i, 100, 814
- Point Pinole, Cal. (*see* San Pablo Bay) ..... i, 583; iii, 2189
- Point Pleasant, Me., bridge to Carlows Island ..... i, 652
- Point Wilson, Cal. (*see* San Pablo Bay) ..... i, 583; iii, 2189
- Pokegama Falls, Mississippi River, Minn.:
  - Construction of reservoir dam ..... i, 398; ii, 1528
  - Operating and care of reservoir dam ..... i, 399; ii, 1538
- Pollock Rip light-ship, Mass., removal of wreck ..... i, 103, 819
- Pomeroy, Ohio, ice harbor at Kerrs Run (*see* Ohio River) ..... i, 423; ii, 1627
- Pomeroy Center, Ohio, ice pier (*see* Ohio River) ..... i, 423; ii, 1627
- Ponchatoula River, La. (*see* Tickfaw River) ..... i, 338; ii, 1303
- Pony Slough, Coos Bay, Oreg., improvement of ..... i, 595; iii, 2209
- Popes Island, Va., removal of wreck ..... i, 194, 1024
- Porcupine Island, Bar Harbor, Me., construction of breakwater ..... i, 39, 714
- Portage Lake, Manistee County, Mich., improvement of harbor of ref-  
uge ..... i, 517; iii, 1973
- Portage Lake and Lake Superior canals, Houghton County, Mich.:
  - Improvement and care ..... i, 471, 472; ii, 1815
  - Removal of wreck ..... i, 475; ii, 1827
- Portage River, Houghton County, Mich., waterway via ..... i, 471, 472; ii, 1815
- Portage River, Ohio (*see* Port Clinton Harbor) ..... i, 543; iii, 2055
- Port Arthur Canal, Tex., connection with Sabine Lake ..... i, 344; ii, 1314
- Port Chester Harbor, N. Y., improvement of ..... i, 123, 858
- Port Clinton Harbor, Ohio, improvement of ..... i, 543; iii, 2055
- Port Harford, Cal. (*see* San Luis Obispo Harbor) ..... i, 578; iii, 2179
- Port Huron, Mich.:
  - Improvement of Black River at ..... i, 529; iii, 1996
  - Removal of wreck in St. Clair River near ..... iii, 2047
- Port Jefferson Harbor, N. Y., improvement of ..... i, 127, 865
- Portland, Ky.:
  - Enlargement of Louisville and Portland Canal ..... i, 452; ii, 1763
  - Operating and care of Louisville and Portland Canal ..... i, 455; ii, 1765
- Portland, Me.:
  - Defenses of, including report on telephone booths and damp-proof-  
ing ..... i, 9; iv, 2371
  - Improvement of harbor ..... i, 51, 725
- Porto Rico, defenses of ..... i, 8, 9, 14, 17
- Port Reading, N. J., removal of wreck in Arthur Kill ..... i, 159, 956
- Port Royal (Beaufort) River, S. C.:
  - Defenses of Port Royal Sound, including report on damp-proofing... i, 9; iv, 2409
  - Improvement of ..... i, 256; ii, 1139
  - Improvement of waterway between Beaufort and Charleston,  
S. C. .... i, 255; ii, 1138
  - Improvement of waterway between Beaufort, S. C., and Savannah (*see*  
Savannah Harbor) ..... i, 257; ii, 1141
  - Removal of logs from waterway between Beaufort and Charleston,  
S. C. .... i, 257; ii, 1140

- Port Royal Sound, S. C., defenses of, including report on damp-proofing..... i, 9; iv, 2409
- Portsmouth, N. H., defenses at, including report on damp-proofing..... i, 9; iv, 2374
- Portsmouth, Ohio, ice pier (*see* Ohio River)..... i, 423; ii, 1627
- Port Tampa, Fla. (*see* Tampa Bay)..... i, 284; ii, 1198
- Port Washington Harbor, Wis., improvement of..... i, 484; ii, 1855
- Portwing Harbor, Wis., improvement of..... i, 468; ii, 1809
- Position finders, range and..... i, 12, 15, 17
- Posts, military:
- Fort Leavenworth, Kans..... i, 5, 21, 23, 703
  - Fort Totten, N. Y., building for School of Submarine Defense..... i, 13, 16
  - Washington Barracks, D. C..... i, 17, 674, 675, 683; iv, 2934
- Potomac Park, Washington, D. C..... i, 658; iv, 2517
- Potomac River (*see also* Washington, D. C.):
- Aqueduct Bridge, Washington, D. C., repair of..... i, 652; iv, 2483
  - Defenses of Washington, D. C., including report on damp-proofing..... i, 9; iv, 2405
  - Highway bridge at Washington, D. C., to replace Long Bridge..... i, 643, 653; iv, 2484
  - Improvement at Washington, D. C..... i, 197; ii, 1035
  - Improvement below Washington, D. C..... i, 200; ii, 1038
  - Improvement of Eastern Branch (Anacostia River)..... i, 200; ii, 1040
  - Memorial Bridge, Washington, D. C..... i, 653; iv, 2484
  - Wreck near River View, Md..... i, 218; ii, 1071
- Potter, Sarah (schooner), removal of wreck of..... i, 103, 820
- Powow River, Mass., improvement of..... i, 61, 740
- Prairie du Chien, Wis., bridge across Wisconsin River..... i, 648
- Precipitation (rain), evaporation, and outflow in valley of Northern and Northwestern Lakes..... i, 665; iv, 2855
- Preliminary examinations of rivers and harbors. *See* Examinations.
- Presque Isle Harbor, Marquette, Mich., harbor of refuge..... i, 474; ii, 1823
- Presque Isle Peninsula, Erie, Pa., improvements at, use of land for water-supply purposes, status of title, etc..... i, 657; iii, 2115, 2117
- Printing Office, Government, Washington, D. C.:
- Construction of new building for..... i, 673; iv, 2919
  - Telegraph line..... i, 659; iv, 2517
- Projectors, searchlight..... i, 14, 15, 16, 17; iv, 2425
- Projects. *See* Fortifications and Rivers and harbors.
- Providence Harbor and River, R. I.:
- Harbor lines in Pawtucket (Seekonk) and Providence rivers..... i, 640, 825
  - Improvement of..... i, 96, 801
  - Improvement of Pawtucket River..... i, 95, 799
  - Removal of Green Jacket shoal..... i, 96, 803
- Provincetown Harbor, Mass., improvement of..... i, 87, 783
- Public buildings and grounds, District of Columbia..... i, 658; iv, 2517
- Public parks. *See* Parks.
- Puget Sound, Wash.:
- Bridge at Seattle, across Lake Washington Canal right of way..... i, 645
  - Defenses of..... i, 9
  - Improvement of, and tributaries..... i, 625; iii, 2328
  - Improvement of waterway to Lake Washington..... i, 629; iii, 2332
  - Reexamination of waterway to Lake Washington, with plans and estimates of cost..... i, 630; iii, 2340
- Puntalunos (vessel), removal of wreck of..... i, 271; ii, 1171
- Purification of water supply of Washington, D. C., with report concerning preliminary treatment of Potomac water..... i, 657; iv, 2505, 2511
- Puyallup River, Wash.:
- Bridge at Tacoma..... i, 648
  - Improvement of (*see* Puget Sound)..... i, 625; iii, 2328
  - Improvement of Tacoma Harbor..... i, 627; iii, 2331

## Q.

- Queenstown Harbor, Md., improvement of..... i, 185, 1007
- Quinnipiac River, New Haven, Conn., improvement of..... i, 110, 839
- Quito (steamer), removal of wreck of..... i, 556; iii, 2104



## R.

- Raccoon Creek, N. J., improvement of ..... i, 173, 991
- Racine Harbor, Wis.:  
 Improvement of ..... i, 486; ii, 1861  
 Reef in Lake Michigan near Wind Point ..... i, 665; iv, 2883
- Railway, boat, Columbia River, Oreg. and Wash ..... i, 604; iii, 2221
- Rainfall, evaporation, and outflow in valley of Northern and Northwestern  
 Lakes ..... i, 665; iv, 2855
- Rainier, Mount, National Park, Wash., survey for road ..... i, 37
- Raisin River, Mich. (*see* Monroe Harbor) ..... i, 528; iii, 1995
- Ram Island light-house, Boothbay Harbor, Me., removal of wreck ..... i, 53, 727
- Rancocas River, N. J.:  
 Bridge at Hainesport ..... i, 647  
 Improvement of ..... i, 166, 984  
 Removal of wreck ..... i, 194, 1023
- Range and position finders ..... i, 12, 15, 17
- Ranges, rifle ..... i, 17, 686
- Rappahannock River, Va., improvement of ..... i, 210; ii, 1058
- Raritan Bay and River, N. J.:  
 Improvement of bay ..... i, 150, 937  
 Improvement of Keyport Harbor ..... i, 151, 939  
 Improvement of river ..... i, 152, 943  
 Improvement of Shoal Harbor ..... i, 154, 948  
 Removal of wreck at Metuchen ..... i, 159, 955
- Reconnaissances and explorations, military, with report on technical fea-  
 tures of engineer operations in the former department of North Philip-  
 pines, and present department of Luzon ..... i, 667; iv, 2478, 2903
- Red Hook channel, New York Harbor, N. Y., improvement of ..... i, 142, 915
- Red Lake, Minn.:  
 Improvement of (*see* Red River of the North) ..... i, 401; ii, 1543  
 Survey of ..... i, 403; ii, 1548
- Red Lake River, Minn.:  
 Improvement of (*see* Red River of the North) ..... i, 401; ii, 1543  
 Survey of ..... i, 403; ii, 1548
- Red River, La., Ark., Tex., and Ind. T.:  
 Bridge between Alexandria and Pineville, La. (Alexandria and Pine-  
 ville Bridge Company) ..... i, 644  
 Bridge between Alexandria and Pineville, La. (Shreveport and Red  
 River Valley Railway Company) ..... i, 643  
 Bridge near Shreveport, La. .... i, 643  
 Gauging (*see* Mississippi River Commission) ..... i, 639; S., 7, 8, 62, 97  
 Improvement of ..... i, 361; ii, 1363  
 Rectification of mouth by Mississippi River Commission ..... i, 639; S., 3, 40
- Red River of the North, Minn. and N. Dak.:  
 Improvement of ..... i, 401; ii, 1543  
 Survey of Otter Tail Lake and River for reservoir dam ..... i, 404; ii, 1548  
 Survey of Red Lake and Red Lake River for reservoir dam ..... i, 403; ii, 1548
- Redwood Creek, Cal., improvement of ..... i, 581; iii, 2182
- Reflectors, searchlight ..... i, 14, 15, 16, 17; iv, 2425
- Regulations and rules:  
 For navigation of canals, etc. .... i, 641  
 For opening of drawbridges ..... i, 642
- Rehoboth Bay, Del., waterway via ..... i, 180, 1002
- Reservations, public. *See* Parks.
- Reservoirs:  
 Big Stone Lake, Minn., survey of ..... i, 404; ii, 1549  
 Mississippi River, headwaters, construction of ..... i, 398; ii, 1528  
 Mississippi River, headwaters, operating and care ..... i, 399; ii, 1538  
 Mississippi River, headwaters, survey of flowage lines ..... i, 398; ii, 1532  
 Otter Tail Lake and River, Minn., survey of ..... i, 404; ii, 1548  
 Red Lake and Red Lake River, Minn., survey of ..... i, 403; ii, 1548  
 Traverse Lake, Minn., survey of ..... i, 404; ii, 1549  
 Washington Aqueduct, D. C. .... i, 654, 655; iv, 2485, 2499
- Revere, Mass., bridge across Saugus River to Lynn ..... i, 650
- Rice Irrigation and Improvement Association of Louisiana, lock and dam  
 in Mermentau River ..... i, 641
- Richland Creek, Tenn. (*see* Tennessee River above Chattanooga) ..... i, 417; ii, 1592

- Richmond Harbor, Va. (*see* James River) ..... I, 216; II, 1065
- Rifle ranges ..... I, 17, 686
- Ringleader (barge), removal of wreck of ..... I, 145, 924
- Ripley, Ohio, ice pier (*see* Ohio River) ..... I, 423; II, 1627
- Rivers and harbors (*see also* Technical details):
- Appropriations for operations during the past year ..... I, 35
  - Appropriations for 1904-5, estimates of ..... I, 36, 636
  - Board of Engineers for (*see also* Committee, etc.) ..... I, 36, 637
  - Board of Engineers, The ..... I, 8, 679
  - Bridges ..... I, 642, 650, 651
  - Committee on, House of Representatives. *See* Committee, etc.
  - Engineer divisions ..... I, 36
  - Examinations and surveys required to be made by act of 1902 ..... I, 36
  - Expenditures during the past year ..... I, 35
  - Harbor lines, establishment of ..... I, 640
  - Rules governing navigation of canals, etc ..... I, 641
  - Rules governing the opening of drawbridges ..... I, 642
  - Status of works ..... I, 35
- River View, Potomac River, Md., removal of wreck ..... I, 218; II, 1071
- Roads:
- Fort Washakie, Wyo., to Buffalo Fork, Snake River ..... I, 675; IV, 2937
  - In military divisions and departments ..... I, 667; IV, 2478, 2899
  - In Mount Rainier National Park, Wash. .... I, 37
  - In Yellowstone National Park, with technical details concerning construction, etc ..... I, 666; IV, 2444, 2885
- Roanoke River, N. C., improvement of ..... I, 227; II, 1086
- Rochambeau statue, Washington, D. C. .... I, 658; IV, 2517
- Rockhall Harbor, Md., improvement of ..... I, 184, 1005
- Rockhaven, N. Dak., ice harbor (*see* Missouri River) ..... I, 406; II, 1551
- Rockland Harbor, Me.:
- Harbor lines in Lermonds Cove ..... I, 640, 727
  - Improvement of ..... I, 47, 721
- Rockport, Mass.:
- Construction of harbor of refuge in Sandy Bay, with report relative to completion of project ..... I, 62, 740, 742
  - Improvement of harbor ..... I, 64, 743
- Rock River, Ill.:
- Construction of canal around ..... I, 496; III, 1920
  - Operating and care of canal around ..... I, 395; II, 1496
- Romerly Marsh, Ga., improvement of waterway via ..... I, 269; II, 1166
- Rondout Harbor, N. Y., improvement of ..... I, 137, 884
- Root River, Wis. (*see* Racine Harbor) ..... I, 486; II, 1861
- Rouge River, Mich., improvement of ..... I, 528; III, 1993
- Rough River, Ky.:
- Improvement of ..... I, 463; II, 1788
  - Operating and care of lock and dam ..... I, 464; II, 1789
- Rules and regulations:
- For navigation of canals, etc ..... I, 641
  - For opening of drawbridges ..... I, 642
- S.
- Sabine Lake, Pass, and River, Tex.:
- Connection with Port Arthur Canal ..... I, 344; II, 1314
  - Improvement of mouth of river and of channel through lake ..... I, 344; II, 1314
  - Improvement of river ..... I, 345; II, 1315
  - Improvement of Sabine Pass Harbor ..... I, 346; II, 1317
- Saco River, Me., improvement of ..... I, 54, 732
- Sacramento County, Cal., bridge of ..... I, 646
- Sacramento River, Cal.:
- Bridge of J. E. Terry across ..... I, 647
  - Improvement of ..... I, 587; III, 2194
  - Improvement of, by California Débris Commission ..... I, 638; III, 2368
- Sag Harbor, N. Y., improvement at ..... I, 130, 870
- Saginaw River, Mich., improvement of ..... I, 524; III, 1986
- St. Augustine Creek, Ga., bridge across ..... I, 652
- St. Augustine Harbor, Fla., improvement of ..... I, 276; II, 1181

- St. Clair Canal and River, Mich.:  
 Improvement of ..... i, 539; iii, 2033  
 Improvement of channels in waters connecting the Great Lakes. i, 532; iii, 2001  
 Operating and care of canal ..... i, 540; iii, 2034  
 Removal of wrecks ..... i, 542; iii, 2046, 2047  
 Surveys, etc. (*see* Northern and Northwestern Lakes) ..... i, 660; iv, 2671
- St. Croix Lake and River, Wis. and Minn., improvement of ..... i, 400; ii, 1540
- St. Francis, Ark., bridge across St. Francis River ..... i, 644
- St. Francis River, Ark. and Mo.:  
 Bridge in Lee County, Ark. .... i, 644  
 Bridge at St. Francis, Ark. .... i, 644  
 Gauging (*see* Mississippi River Commission) ..... i, 639; S., 7, 8, 62, 97  
 Improvement of, in Arkansas ..... i, 386; ii, 1436  
 Improvement of, in Missouri ..... i, 388; ii, 1438
- St. George Sound, Fla. (*see* Carrabelle bar and harbor) ..... i, 290; ii, 1207
- St. Johns River, Fla.:  
 Defenses of, including report on damp-proofing ..... i, 9; iv, 2413  
 Harbor lines at Jacksonville ..... i, 640; ii, 1187  
 Improvement between Jacksonville and the ocean, including dredge construction ..... i, 271, 976; ii, 1173  
 Improvement between Jacksonville and Palatka, including Orange Mills flats ..... i, 273; ii, 1178  
 Improvement of Volusia bar, and between Volusia bar and Lake Monroe ..... i, 274; ii, 1179  
 Removal of water hyacinths, including report on experiments made ..... i, 279; ii, 1184; iv, 2433
- St. Jones River, Del. (*see* Murderkill River) ..... i, 177, 996
- St. Joseph Harbor and River, Mich.:  
 Improvement of harbor ..... i, 501; iii, 1937  
 Improvement of river ..... i, 501, 502; iii, 1938
- St. Lawrence River, N. Y.:  
 Cape Vincent Harbor, improvement of ..... i, 572; iii, 2162  
 Defenses of ..... i, 8, 9  
 Long Sault Island, improvement at head of ..... i, 574; iii, 2168  
 Ogdensburg Harbor, improvement of ..... i, 573; iii, 2165  
 Ogdensburg to foot of Lake Ontario, removal of shoals ..... i, 573; iii, 2165
- St. Lawrence River Power Company ..... i, 574; iii, 2168
- St. Louis, Mo.:  
 Harbor lines in Mississippi River ..... i, 640; ii, 1455  
 Improvement of Mississippi River between mouths of Missouri and Ohio rivers. .... i, 390; ii, 1445  
 Survey for waterway to Lockport, Ill. .... i, 494, 639; iii, 1904; S., 7, 68, 167
- St. Louis Bay and River, Minn. and Wis. (*see* Duluth Harbor) ..... i, 466; ii, 1794
- St. Mary Park Association, bridge of ..... i, 650
- St. Marys River and St. Marys Falls Canal, Mich.:  
 Commercial statistics ..... i, 535; iii, 2010, 2015  
 Improvement of channels in waters connecting the Great Lakes. i, 532; iii, 2001  
 Improvement of Hay Lake and Neebish channels ..... i, 537; iii, 2027  
 Improvement of river at the falls ..... i, 534; iii, 2006  
 Operating and care of canal ..... i, 535; iii, 2010  
 Surveys, etc. (*see* Northern and Northwestern Lakes) ..... i, 660; iv, 2671  
 Survey for improvement, final report on ..... i, 542  
 Water-power canal at Sault Ste. Marie ..... i, 641
- St. Paul, Minn.:  
*See also* Mississippi River.  
 Gauging Mississippi River at ..... i, 405; ii, 1549  
 Harbor lines in Mississippi River at ..... i, 640; ii, 1513
- St. Peters River, Minn. *See* Minnesota River.
- St. Thomas (schooner), removal of wreck of ..... i, 103, 819
- Sakonnet River, R. I., improvement of ..... i, 94, 798
- Salmon Bay, Wash.:  
 Improvement of waterway via ..... i, 629; iii, 2332  
 Reexamination of waterway via, with plans and estimates of cost. i, 630; iii, 2340
- Salmon River, Conn. (*see* Connecticut River) ..... i, 107, 836
- Samamish Lake, Wash. *See* Puget Sound-Lake Washington waterway.
- Sampit River (Georgetown Harbor), S. C. (*see* Winyah Bay) ..... i, 246; ii, 1122
- San Antonio estuary, Cal. (*see* Oakland Harbor) ..... i, 582; iii, 2186

- Sandbeach, Mich.:
  - Improvement of harbor of refuge ..... i, 526; iii, 1989
  - Water levels ..... i, 665; iv, 2678
- San Diego Harbor, Cal.:
  - Defenses of ..... i, 9
  - Improvement of ..... i, 575; iii, 2171
- Sandusky Harbor, Ohio, improvement of, including dredge construction ..... i, 545, 979; iii, 2057
- Sandwich Islands. *See* Hawaiian Islands.
- Sandy Bay, Cape Ann, Mass.:
  - Construction of harbor of refuge, with report relative to completion of project ..... i, 62, 740, 742
  - Improvement of Rockport Harbor ..... i, 64, 743
- Sandy Lake, Minn.:
  - Construction of reservoir dam ..... i, 398; ii, 1528
  - Operating and care of reservoir dam ..... i, 399; ii, 1538
- San Francisco Bay and Harbor, Cal.:
  - Defenses of, including report on construction methods, damp-proofing, and transportation of ordnance ..... i, 9; iv, 2417
  - Harbor lines north of China Basin and Mission rock ..... i, 640; iii, 2202
  - Improvement of channel between Straits of Karquines and the Golden Gate ..... i, 583; iii, 2189
  - Improvement of harbor ..... i, 582; iii, 2184
  - Improvement of Oakland Harbor ..... i, 582; iii, 2186
- Sanitary District of Chicago, Ill., connection of Chicago River with drainage canal ..... i, 640
- San Jacinto River, Tex.:
  - Bridge across ..... i, 648
  - Improvement of (*see* Galveston ship channel) ..... i, 351; ii, 1334
- San Joaquin County, Cal., bridge of ..... i, 646
- San Joaquin River, Cal.:
  - Bridge across Mormon channel at Stockton ..... i, 648
  - Improvement of ..... i, 584; iii, 2190
  - Improvement of, by California Débris Commission ..... i, 638; iii, 2368
  - Improvement of Stockton and Mormon channels ..... i, 584, 585; iii, 2190, 2193
- San Juan, P. R., defenses of ..... i, 8, 9, 14, 17
- Sankaty Head, Nantucket Island, Mass., removal of wrecks near Bass Rip ..... i, 104, 820
- San Leandro Bay, Cal.:
  - Bridge between Alameda and Bay Farm Island ..... i, 646
  - Improvement of (*see* Oakland Harbor) ..... i, 582; iii, 2186
- San Luis d'Apra, Guam, defenses of ..... i, 8, 9, 14, 17
- San Luis Obispo Harbor, Cal., improvement of ..... i, 578; iii, 2179
- San Pablo Bay, Cal., improvement of ..... i, 583; iii, 2189
- San Pedro Bay and Harbor, Cal.:
  - Construction of deep-water harbor ..... i, 576; iii, 2173
  - Improvement of Wilmington inner harbor ..... i, 577; iii, 2175
- Santee River, S. C., improvement of ..... i, 248; ii, 1127
- Sarasota Bay, Fla., improvement of ..... i, 284; ii, 1197
- Saugatuck Harbor, Mich., improvement of ..... i, 504; iii, 1945
- Saugatuck River, Conn., improvement of ..... i, 118, 849
- Saugerties Harbor, N. Y., improvement of ..... i, 136, 883
- Saugus River, Mass.:
  - Bridge between Revere and Lynn ..... i, 650
  - Improvement of Lynn Harbor ..... i, 73, 759
- Sauk River, Wis. (*see* Port Washington Harbor) ..... i, 484; ii, 1855
- Sault Ste. Marie, Mich. *See* St. Marys River.
- Sausal Creek, Cal. (*see* Oakland Harbor) ..... i, 582; iii, 2186
- Savannah and Tybee Railroad, bridge across St. Augustine Creek, Ga. .... i, 652
- Savannah Harbor and River, Ga.:
  - Defenses of ..... i, 9
  - Improvement of harbor, including dredge construction ..... i, 257, 980; ii, 1141
  - Improvement of river above Augusta ..... i, 261; ii, 1155
  - Improvement of river between Augusta and Savannah ..... i, 260; ii, 1152
  - Improvement of waterway to Beaufort, S. C. (*see* Savannah Harbor) ..... i, 257; ii, 1141
  - Improvement of waterway to Fernandina, Fla. .... i, 269; ii, 1166
  - Removal of wreck in harbor ..... i, 271; ii, 1171

- Sawyer, Emily G. (schooner), removal of wreck of ..... i, 103, 820
- Sayville, N. Y., improvement of Browns Creek ..... i, 133, 874
- Schools:
- Engineer School of Application ..... i, 19, 674, 675, 689; iv, 2934
  - School of Submarine Defense, building for ..... i, 13, 16
- Schuylkill River, Pa.:
- Bridge at Market street, Philadelphia ..... i, 648
  - Removal of wreck ..... i, 194, 1024
- Scituate Harbor, Mass., improvement of, including report on project by the Board of Engineers for Rivers and Harbors ..... i, 84, 777
- Scuppernon River, N. C., improvement of ..... i, 229; ii, 1091
- Seacoast defenses. *See* Fortifications.
- Searchlights, including notes on projectors ..... i, 14, 15, 16, 17; iv, 2425
- Seattle, Wash.:
- Bridge across right of way of Puget Sound-Lake Washington waterway ..... i, 645
  - Improvement of Puget Sound-Lake Washington waterway ..... i, 629; iii, 2332
  - Reexamination of Puget Sound-Lake Washington waterway, with plans and estimates of cost ..... i, 630; iii, 2340
- Seattle and Montana Railroad Company, bridges of ..... i, 645, 647
- Seattle and Renton Railway Company, bridge of ..... i, 645
- Sea walls ..... i, 13, 16, 17
- Sebewaing River, Mich., improvement of ..... i, 525; iii, 1987
- Secretary Creek (Warwick River), Md., improvement of ..... i, 188, 1014
- Seekonk (Pawtucket) River, R. I.:
- Harbor lines at Providence ..... i, 640, 825
  - Improvement of ..... i, 95, 799
- Service of officers of Corps of Engineers abroad and in the field, with troops ..... i, 24
- Shag rocks, San Francisco Harbor, Cal., removal of ..... i, 582; iii, 2184
- Shaws Cove, New London, Conn. *See* New London and Thames River.
- Sheboygan Harbor, Wis., improvement of ..... i, 483; ii, 1853
- Sheridan statue, Washington, D. C. .... i, 658; iv, 2517
- Sherman statue, Washington, D. C. .... i, 658; iv, 2517
- Sherman, Will (barge), removal of wreck of ..... i, 158, 955
- Shiawassee River, Mich., improvement of ..... i, 525; iii, 1986
- Shilshole Bay, Wash.:
- Improvement of waterway via ..... i, 629; iii, 2332
  - Reexamination of waterway via, with plans and estimates of cost ..... i, 630; iii, 2340
- Ship channel connecting waters of the Great Lakes, improvement of ..... i, 532; iii, 2001
- Ship Island Harbor, Miss., improvement of channel to Gulfport ..... i, 320; ii, 1266
- Ship John light-house, Delaware Bay, removal of wrecks ..... i, 165, 971, 972
- Shipyards Landing, Pasquotank River, N. C., removal of cribs of logs ..... i, 228; ii, 1088
- Shoal Harbor, N. J., improvement of ..... i, 154, 948
- Shoalwater Bay (Willapa Harbor), Wash., improvement of ..... i, 620; iii, 2323
- Shovelful Shoal, Mass., removal of wreck ..... i, 103, 819, 820
- Shreveport, La.:
- Bridge across Red River near ..... i, 643
  - Improvement of Red River at ..... i, 361; ii, 1363
  - Waterway to Jefferson, Tex. (*see* Cypress Bayou) ..... i, 365; ii, 1372
- Shreveport and Red River Valley Railway Company:
- Bridge of, across Bayou des Glaisses, La. .... i, 648
  - Bridge of, across Red River, La. .... i, 643
- Shreveport Bridge and Terminal Company, bridge of ..... i, 643
- Shrewsbury River, N. J., improvement of ..... i, 155, 950
- Simmons Ferry, Little River, La., bridge near ..... i, 650
- Sinepuxent Bay, Md., waterway via ..... i, 180, 1002
- Sioux City, Iowa. *See* Missouri River.
- Sioux River, S. Dak., ice harbor at Sioux City, Iowa ..... i, 406; ii, 1551
- Sites for fortifications ..... i, 13, 14, 15, 17
- Siuslaw River, Oreg.:
- Examination and survey at mouth and at and near Florence ..... i, 599; iii, 2229
  - Improvement at mouth ..... i, 598; iii, 2213
- Six-mile Island, Allegheny River, Pa., construction of lock and dam ..... i, 438; ii, 1680
- Skagit River, Wash. (*see* Puget Sound) ..... i, 625; iii, 2328
- Skykomish River, Wash. (*see* Puget Sound) ..... i, 625; iii, 2328
- Slack-water systems. *See* Canals and Waterways.
- Smith Creek, Norfolk Harbor, Va., harbor lines ..... i, 640; ii, 1089

- Smiths Cove, Thames River, Conn., bridge near New London ..... i, 652
- Smyrna River, Del., improvement of ..... i, 179, 1000
- Snag boats recently authorized:
- See also* Dredge boats.
- Florida, for works in ..... i, 280; ii, 1186
- Texas coast ..... i, 354; ii, 1339
- Trinity River, Tex ..... i, 354; ii, 1338
- Snake River, Idaho, Oreg., and Wash.:
- Improvement of ..... i, 602; iii, 2218
- Road from Buffalo Fork to Fort Washakie, Wyo. .... i, 675; iv, 2937
- Survey between Lewiston, Idaho, and mouth of Imnaha River.. i, 603; iii, 2246
- Snodgrass Slough, Cal., bridge across Mokelumne River near mouth of.... i, 646
- Snohomish River, Wash.:
- Improvement of (*see* Puget Sound)..... i, 625; iii, 2328
- Improvement of Everett Harbor ..... i, 631; iii, 2334
- Snoqualmie River, Wash. (*see* Puget Sound) ..... i, 625; iii, 2328
- Soda Lakes, La. (*see* Cypress Bayou) ..... i, 365; ii, 1372
- Sopchoppy, Fla., bridges across Ocklockonee and Sopchoppy rivers near... i, 652
- Sopchoppy River, Fla., bridge near Sopchoppy ..... i, 652
- Sorrel Bayou, La. (*see* Bayou Plaquemine) ..... i, 332; ii, 1289
- South Atlantic States, removal of water hyacinths from Florida waters, including report on experiments made ..... i, 279; ii, 1184; iv, 2433
- South Branch, Chicago River, Ill. *See* Chicago Harbor and River.
- South Bristol, Me., bridge across the Gut ..... i, 652
- South Carolina, defenses of coast, including report on damp-proofing.. i, 9; iv, 2409
- South Chicago Harbor, Ill. (*see* Calumet Harbor) ..... i, 493; iii, 1896
- South Edisto River, S. C., waterway via, with estimates of cost..... i, 255; ii, 1132
- South End Bridge, across Connecticut River between Springfield and Agawam, Mass ..... i, 652
- Southern Branch, Elizabeth River, Va.:
- Improvement of Norfolk Harbor and its approaches, including Hospital Point..... i, 219; ii, 1074
- Improvement of waterway to Albemarle Sound, via Currituck Sound ..... i, 226; ii, 1084
- Improvement of waterway to sounds of North Carolina, via Pasquotank River..... i, 225; ii, 1083
- Southern Pacific Company:
- Bridge of, across Calcasieu River, La..... i, 648
- Bridge of, across Mormon channel, Stockton, Cal..... i, 648
- Southern Railway Company, bridge of..... i, 646
- South Haven Harbor, Mich., improvement of ..... i, 503; iii, 1942
- South Hero Island channel, Lake Champlain, Vt., improvement of..... i, 69
- South Kingston, R. I.:
- Construction of Point Judith harbor of refuge, with report on easterly detached breakwater ..... i, 99, 807, 809
- Improvement of entrance to Point Judith Pond ..... i, 100, 814
- South Milwaukee Harbor, Wis., improvement of ..... i, 486; ii, 1860
- South Norwalk Harbor, Conn. (*see* Norwalk) ..... i, 118, 849
- South Pass, Mississippi River:
- Examinations and surveys..... i, 328; ii, 1278
- Maintenance of channel..... i, 328; ii, 1279
- Southport Harbor, Conn., improvement of..... i, 120, 851
- South River, N. J., improvement of ..... i, 153, 945
- Southwest Baltimore, Md., improvement of harbor of..... i, 197; ii, 1031
- Southwest Pass, Mississippi River, La., improvement of, including dredge construction ..... i, 326, 980; ii, 1277
- Southwest Spit, New York Harbor, N. Y., removal of obstructions ..... i, 145, 925
- Sparrow Point, Baltimore Harbor, Md., harbor lines in Patapasco River. i, 640; ii, 1033
- Springdale, Pa., construction of lock and dam in Allegheny River... i, 438; ii, 1680
- Springfield, Mass., South End Bridge across Connecticut River to Agawam. i, 652
- Spring Garden, Baltimore, Md.:
- Bridge at ..... i, 649
- Improvement of harbor at ..... i, 197; ii, 1031
- Spring Lake, Mich., bridge across Grand River to Grand Haven..... i, 649
- Spuyten Duyvil Creek, N. Y. (*see* Harlem River)..... i, 132, 872
- Squan (Manasquan) River, N. J., improvement of..... i, 157, 953

- Stage Harbor, Mass. (*see* Chatham Harbor) ..... i, 88, 785
- Stamford Harbor, Conn., improvement of ..... i, 120, 850
- Starve Island reef, Lake Erie, removal of wreck ..... i, 556; ii, 2105
- Staten Island, N. Y., recommendation for stone monuments to mark established harbor lines ..... i, 141
- Staten Island Sound (Arthur Kill), N. Y. and N. J.:  
     *See also* Staten Island.  
     Improvement of ..... i, 147, 932  
     Removal of wrecks ..... i, 158, 159, 955, 956
- Statistics of commerce, Sault Ste. Marie canals, Mich. .... i, 535; iii, 2010, 2015
- Statues, memorials, etc.:  
     In public grounds, Washington, D. C. .... i, 658; iv, 2517  
     Memorial Bridge, Washington, D. C. .... i, 653; iv, 2484  
     Monuments to Gens. Francis Nash and William Lee Davidson .. i, 676; iv, 2939
- Steamboats:  
     *See also* Dredge and Snag boats, and Wrecks.  
     Rules governing running of, on certain streams ..... i, 641
- Steelmanville, N. J., bridge across Patcong Creek ..... i, 651
- Steubenville, Ohio, bridge across Ohio River to Cross Creek Township, W. Va. .... i, 644
- Steubenville Bridge Company, bridge of ..... i, 644
- Stillaguamish River, Wash. (*see* Puget Sound) ..... i, 625; iii, 2328
- Still Bluff, N. C., bridge across Black River ..... i, 648
- Stillwater Harbor, Minn. (*see* St. Croix River) ..... i, 400; ii, 1540
- Stockbridge Landing, Lake Winnebago, Wis. (*see* Fox River) ..... i, 489; ii, 1866
- Stockton, Cal.:  
     *See also* San Joaquin River.  
     Bridge across Mormon channel ..... i, 648
- Stockton channel, San Joaquin River, Cal., improvement of. i, 584, 585; iii, 2190, 2193
- Stone Bridge, Sakonnet River, R. I., alteration of ..... i, 94, 798
- Studhams, Milton R. (schooner), removal of wreck of ..... i, 165, 971
- Sturgeon Bay and Lake Michigan Canal, Wis.:  
     Improvement of, including harbor of refuge ..... i, 478; ii, 1841  
     Operating and care ..... i, 480; ii, 1846
- Subic Bay, Philippine Islands, defenses of ..... i, 8, 9, 14, 17
- Submarine defense, including building for school of, etc. .... i, 13, 15, 16, 17
- Sullivan Falls Harbor, Me., improvement of ..... i, 40, 714
- Sullivan Island shore, Charleston, S. C., improvement at ..... i, 253; ii, 1134
- Sullivan River, Me., improvement of Sullivan Falls Harbor ..... i, 40, 714
- Sulphur River, Ark. and Tex. (*see* Red River) ..... i, 361; ii, 1363
- Sunken craft. *See* Wrecks.
- Superior Bay and Harbor, Wis.:  
     Improvement of ..... i, 466; ii, 1794  
     Removal of wreck in Lake Superior ..... ii, 1828
- Superior Lake (*see also* Northern and Northwestern Lakes):  
     Commercial statistics, Sault Ste. Marie canals, Mich. .... i, 535; iii, 2010, 2015  
     Final report on survey of waterway to Lake Huron ..... i, 542  
     Harbor lines at Duluth, Minn ..... i, 640; ii, 1828  
     Improvement and care of waterway to Keweenaw Bay ..... i, 471, 472; ii, 1815  
     Removal of wreck in waterway to Keweenaw Bay ..... i, 475; ii, 1827  
     Removal of wrecks near Duluth ..... ii, 1828  
     Water levels ..... i, 665; iv, 2678  
     Water-power canal at Sault Ste. Marie, Mich. .... i, 641
- Supervision of New York Harbor, N. Y. .... i, 637; iii, 2359
- Surface levels. *See* Gauging.
- Surveys:  
     In military divisions and departments, with report on technical features of engineer operations in the former department of North Philippines, and present department of Luzon ..... i, 667; iv, 2478, 2903
- Northern and Northwestern Lakes ..... i, 660; iv, 2671
- Of rivers and harbors, estimate of appropriation for ..... i, 636
- Of rivers and harbors required to be made by act of 1902. .... i, 36
- Susquehanna River, Md., improvement of ..... i, 183, 1004
- Sutton (steamer), removal of wreck of ..... i, 194, 1024
- Suwanee River, Fla., improvement of ..... i, 288; ii, 1202
- Swinomish Slough, Wash., improvement of ..... i, 632; iii, 2336
- Synepuxent Bay, Md., waterway via ..... i, 180, 1002
- Syracuse, Ohio, ice pier (*see* Ohio River) ..... i, 423; ii, 1627

## T.

- Tacoma Harbor, Wash.:  
 Bridge across Puyallup River..... I, 648  
 Improvement of..... I, 627; III, 2331
- Tallahatchie River, Miss., improvement of..... I, 373; II, 1396
- Tampa Bay and Harbor, Fla.:  
 Defenses of, including report on damp-proofing..... I, 9; IV, 2413  
 Improvement of bay..... I, 284; II, 1198  
 Improvement of Hillsboro Bay and River..... I, 285; II, 1200
- Tangier Sound, Md., removal of wrecks in Deal Island Harbor..... I, 194, 1024
- Tanks, cable..... I, 13, 15, 17
- Target firing..... I, 17, 686
- Tar River, N. C., improvement of..... I, 231; II, 1094
- Taunton River, Mass.:  
 Improvement of..... I, 93, 796  
 Improvement of Fall River Harbor..... I, 97, 803
- Tchefuncte River, La., improvement of..... I, 337; II, 1301
- Tchula Lake, Miss., improvement of..... I, 373; II, 1396
- Teche Bayou, La.:  
 Bridge at Franklin..... I, 650  
 Improvement of..... I, 334; II, 1295  
 Removal of water hyacinths, including report on experiments made in the Florida district..... I, 343; II, 1312; IV, 2433
- Technical details of engineering methods..... IV, 2371
- Baltimore, Md., defenses of, damp-proofing..... IV, 2400
- Boston, Mass., defenses of, damp-proofing..... IV, 2374
- Columbia River, defenses of mouth, construction methods and speaking tubes..... IV, 2423
- Florida, defenses of coast, damp-proofing..... IV, 2413
- Galveston, Tex., defenses of, damp-proofing..... IV, 2416
- Key West, Fla., defenses of, damp-proofing..... IV, 2413
- Long Island Sound, defenses of eastern entrance, damp-proofing..... IV, 2387
- Maine, defenses of coast, telephone booths and damp-proofing..... IV, 2371
- Missouri River, dike and revetment construction..... IV, 2437
- Mobile, Ala., defenses of, damp-proofing..... IV, 2414
- Narragansett Bay, R. I., defenses of, foundations, damp-proofing, and painting of concrete..... IV, 2384
- New Orleans, La., defenses of, damp-proofing..... IV, 2415
- New York, N. Y., defenses of, damp-proofing..... IV, 2390
- North Carolina, defenses of coast, damp-proofing, and use of paint made of coal tar and kerosene oil..... IV, 2408
- Philippine Islands, engineer operations in the former department of North Philippines, and present department of Luzon..... IV, 2478
- Portsmouth, N. H., defenses of, damp-proofing..... IV, 2374
- San Francisco, Cal., defenses of, construction methods, damp-proofing, and transportation of ordnance..... IV, 2417
- Searchlight projectors, notes on..... IV, 2425
- South Carolina, defenses of coast, damp-proofing..... IV, 2409
- Tampa, Fla., defenses of, damp-proofing..... IV, 2413
- Washington, D. C., defenses of, damp-proofing..... IV, 2405
- Water hyacinths, report on experiments for destruction of, in Florida waters..... IV, 2433
- Yellowstone National Park, roads, bridges, etc..... IV, 2444
- Telegraph line, Government, Washington, D. C..... I, 659; IV, 2517
- Tennessee Central Railroad Company, bridge of..... I, 643
- Tennessee River:  
 Chattanooga, Tenn., improvement above..... I, 417; II, 1591, 1592  
 Chattanooga, Tenn., to Riverton, Ala., improvement from..... I, 418; II, 1591, 1594  
 Gauging (*see* Mississippi River Commission)..... I, 639; 8., 7, 8, 62, 97  
 Muscle Shoals Canal, Ala., operating and care..... I, 419; II, 1605  
 Riverton, Ala., improvement below..... I, 419; II, 1591, 1598
- Tensas River, La., improvement of..... I, 368, 370; II, 1379
- Terraceia Cut-off, Fla. (*see* Manatee River)..... I, 287; II, 1203
- Terry, J. E., bridge of..... I, 647
- Texas:  
 Dredge and snag boat for certain works in..... I, 354; II, 1339  
 Removal of water hyacinths from waters in..... I, 343
- Texas City, Tex., improvement of channel to Galveston..... I, 351; II, 1331



- Thames River, Conn.:  
 Bridge across Smiths Cove near New London..... i, 652  
 Improvement of..... i, 106, 834  
 Improvement of New London Harbor..... i, 105, 833  
 Thatcher, Addie (schooner), removal of wreck of..... i, 194, 1024  
 The Board of Engineers..... i, 8, 679  
 Three Brothers (sloop), removal of wreck of..... i, 194, 1024  
 Three-mile Rapids, Columbia River, Oreg. and Wash., improvement  
 at..... i, 604; iii, 2221  
 Thunder Bay River, Mich., improvement of Alpena Harbor..... i, 523; iii, 1985  
 Tickfaw River, La., improvement of, including tributaries..... i, 338; ii, 1303  
 Tillamook Bay and bar, Oreg.:  
 Improvement of..... i, 601; iii, 2216  
 Survey of ocean bar..... i, 602; iii, 2239  
 Tiverton, R. I., improvement of Sakonnet River at..... i, 94, 798  
 Toledo Harbor, Ohio:  
 Harbor lines in Maumee River..... i, 640; iii, 2107  
 Improvement of, including dredge construction..... i, 542, 979; iii, 2049  
 Removal of wreck in Maumee Bay..... i, 557; iii, 2106  
 Toledo (steamer), removal of wreck of..... i, 475; ii, 1827  
 Tolomato River, Fla. (*see* St. Augustine Harbor)..... i, 275; ii, 1181  
 Tombigbee River, Ala. and Miss.:  
 Columbus to Walkers Bridge, Miss., improvement from..... i, 313; ii, 1250  
 Demopolis, Ala., improvement below..... i, 310, 311; ii, 1246, 1248  
 Demopolis, Ala., to Columbus, Miss., improvement from..... i, 312; ii, 1249  
 Tompkinsville, N. Y., removal of wreck off..... i, 145, 924  
 Tonawanda Harbor, N. Y., improvement of..... i, 563; iii, 2144  
 Tongue Point, Columbia River, Oreg., improvement below..... i, 614; iii, 2270  
 Tonnage, Sault Ste. Marie canals, Mich..... i, 535; iii, 2010, 2015  
 Torpedoes..... i, 13, 15, 17  
 Totten, Fort, N. Y., building for School of Submarine Defense..... i, 13, 16  
 Tower, F. D. (canal boat), removal of wreck of..... i, 158, 954  
 Town Creek, Brunswick County, N. C., improvement of..... i, 242; ii, 1113  
 Town River, Mass., improvement of..... i, 82, 772  
 Trail Creek, Ind.:  
 Improvement of Michigan City inner harbor..... i, 498; iii, 1931  
 Improvement of Michigan City outer harbor..... i, 498, 499; iii, 1931  
 Traverse Lake, Minn., survey of..... i, 404; ii, 1549  
 Trent River, N. C.:  
 Harbor lines at Newbern..... i, 640; ii, 1114  
 Improvement of..... i, 234; ii, 1099  
 Trinity River, Tex.:  
 Bridge across..... i, 648  
 Improvement of..... i, 354, 355; ii, 1338, 1339  
 Troops:  
 Battalions of Engineers..... i, 5, 7, 18, 669, 686; iv, 2906  
 Engineer equipment of..... i, 23, 697  
 Service of officers of the Corps of Engineers with..... i, 24  
 Tucker Beach light-house, N. J., removal of wreck..... i, 194, 1026  
 Tuckerton Creek, N. J., improvement of..... i, 172, 990  
 Tug Fork, Big Sandy River, W. Va. and Ky., improvement of..... i, 448; ii, 1742  
 Tunnel, Washington Aqueduct, D. C..... i, 654, 655; iv, 2485, 2499  
 Turners Out, N. C., improvement of waterway via..... i, 225; ii, 1083  
 Turtle River, Ga. (*see* Brunswick Harbor)..... i, 267; ii, 1164  
 Twelve-mile Creek, Fla. (*see* Orange River)..... i, 282; ii, 1194  
 Twelve-mile Creek, N. Y. (*see* Wilson Harbor)..... i, 564; iii, 2147  
 Twin Rivers, Wis. (*see* Two Rivers Harbor)..... i, 481; ii, 1850  
 Two Harbors, Minn., improvement of Agate Bay..... i, 465; ii, 1793  
 Two Rivers Harbor, Wis., improvement of..... i, 481; ii, 1850  
 Tyaskin (Wetipquin) Creek, Md., improvement of..... i, 190, 1018

## U.

- Union Bridge Company, bridge of..... i, 651  
 Union Lake, Wash.:  
 Improvement of waterway via..... i, 629; iii, 2332  
 Reexamination of waterway via, with plans and estimates of cost. i, 630; iii, 2340  
 Union River, Me., improvement of..... i, 41, 715

United Railways and Electric Company of Baltimore, Md., bridge of .....	I, 649
United States and West Indies Railroad and Steamship Company, bridge of ..	I, 643
Urbana Creek, Va., improvement of .....	I, 212; II, 1060
Uriarte No. 4 (steamer), removal of wreck of .....	I, 194, 1024

## V.

Vanmatre, A. R., bridge of .....	I, 644
Van Sciver (schooner), removal of wreck of .....	I, 194, 1023
Venango County, Pa.:	
Bridge of, across Allegheny River at Franklin .....	I, 651
Bridge of, across Allegheny River at Kennerdell .....	I, 647
Vermilion Bayou, La., improvement of channel, bay, and passes .....	I, 339; II, 1306
Vermilion Harbor, Ohio, improvement of .....	I, 547; III, 2064

## Vessels:

*See also Dredge and Snag boats, and Wrecks.*

Rules governing running of steamboats on certain streams .....	I, 641
Vicksburg Harbor, Miss., improvement of .....	I, 370; II, 1385
Vidalia Harbor, La. ( <i>see</i> Mississippi River Commission) .....	I, 639; S., 3, 40
Vinalhaven, Me., improvement of Carvers Harbor .....	I, 48, 722
Vineyard Haven, Mass., improvement of harbor at .....	I, 90, 791
Vineyard Sound light-ship, Mass., removal of wreck .....	I, 104, 820
Visayas, department of the, reconnaissances and explorations .....	I, 667, 669; IV, 2903
Volusia bar, St. Johns River, Fla., improvement of .....	I, 274; II, 1179

## W.

## Wabash River, Ind. and Ill.:

Improvement above Vincennes, Ind .....	I, 457, 459; II, 1772
Improvement below Vincennes, Ind .....	I, 457; II, 1772
Operating and care of Grand Rapids lock and dam .....	I, 459; II, 1773

## Waccamaw River, N. C. and S. C.:

Bridge at Conway, S. C. ....	I, 650
Improvement of .....	I, 243; II, 1117

## Wachapreague Inlet life-saving station, Va., removal of wreck .....

I, 194, 1024

## Wadena (barge), removal of wreck of .....

I, 103, 819

## Wade Point light, Albemarle Sound, N. C., removal of wreck .....

I, 228; II, 1088

## Wakefield, Va., wharf at Bridge Creek Landing near .....

I, 660; IV, 2517

## Wallace Creek, S. C., bridge of Colleton County .....

I, 645

## Wand, George H. (schooner), removal of wreck of .....

I, 542; III, 2046

## Wappinger Creek, N. Y., improvement of .....

I, 138, 886

## Wappoo Cut, S. C., improvement of .....

I, 255; II, 1138

## War College, Army, Washington, D. C., buildings for .....

I, 674; IV, 2931

## War maps .....

I, 673

## Warrior River, Ala.:

Improvement above Tuscaloosa .....	I, 309; II, 1244
------------------------------------	------------------

Improvement below Tuscaloosa .....	I, 309; II, 1245
------------------------------------	------------------

Operating and care of locks and dams .....	I, 315; II, 1253, 1256
--	------------------------

Removal of wreck .....	I, 324; II, 1272
------------------------	------------------

## Warroad Harbor and River, Minn., improvement of .....

I, 403; II, 1547

## Warwick River, Md., improvement of .....

I, 188, 1014

## Washakie, Fort, Wyo., road to Buffalo Fork, Snake River .....

I, 675; IV, 2937

## Washington, D. C.:

Aqueduct Bridge across Potomac River, repair of .....	I, 652; IV, 2483
---	------------------

Aqueduct, Dalecarlia reservoir .....	I, 654; IV, 2485
--------------------------------------	------------------

Aqueduct, filtration plant, with report concerning preliminary treat-	
---	--

ment of Potomac water .....	I, 657; IV, 2505, 2511
-----------------------------	------------------------

Aqueduct, increasing water supply .....	I, 655; IV, 2499
---	------------------

Aqueduct, maintenance and repair .....	I, 654; IV, 2485
--	------------------

Aqueduct tunnel and Howard University reservoir ....	I, 654, 655; IV, 2485, 2499
--	-----------------------------

Army War College, buildings for .....	I, 674; IV, 2931
---------------------------------------	------------------

Barracks .....	I, 17, 19, 23, 674, 675, 683; IV, 2934
----------------	--

Battalions of Engineers .....	I, 7, 18, 686; IV, 2906
-------------------------------	-------------------------

Defenses of, including report on damp-proofing .....	I, 9; IV, 2405
--	----------------

Engineer depot .....	I, 19, 23, 694
----------------------	----------------

Engineer School of Application, including buildings ....	I, 19, 674, 675; IV, 2934
--	---------------------------

Executive Mansion and office .....	I, 658; IV, 2517
------------------------------------	------------------

Government Printing Office, new building for .....	I, 673; IV, 2919
--	------------------

## Washington, D. C.—Continued.

- Highway bridge across Potomac River to replace Long Bridge ..... 1, 643, 653; iv, 2484  
 Improvement of Anacostia River at ..... 1, 200; ii, 1040  
 Improvement of Potomac River at ..... 1, 197; ii, 1035  
 Improvement of Potomac River below ..... 1, 200; ii, 1038  
 Memorial Bridge across Potomac River ..... 1, 653; iv, 2484  
 Public buildings and grounds, and Washington Monument ..... 1, 658; iv, 2517  
 Statues and memorials ..... 1, 658; iv, 2517  
 Survey of United States land within flats of Anacostia River ..... 1, 36  
 Washington County (Me.) Railroad Company, bridge of ..... 1, 652  
 Washington Lake, Wash.:  
   Bridge at Seattle, across right of way of waterway to Puget Sound ..... 1, 645  
   Improvement of waterway to Puget Sound ..... 1, 629; iii, 2332  
   Reexamination of waterway to Puget Sound, with plans and estimates of cost ..... 1, 630; iv, 2340  
 Washington Monument, D. C. .... 1, 658; iv, 2517  
 Washington Parish, La., bridge of ..... 1, 650  
 Washita (Ouachita) River, Ark. and La., improvement of ..... 1, 366; ii, 1373  
 Water craft:  
   *See also Dredge and Snag boats, and Wrecks.*  
   Rules governing running of steamboats on certain streams ..... 1, 641  
 Wateree River, S. C.:  
   Bridge near Kingsville ..... 1, 646  
   Improvement of ..... 1, 249; ii, 1128  
 Water hyacinths:  
   Removal of, from Florida waters, including report on experiments made ..... 1, 279; ii, 1184; iv, 2433  
   Removal of, from Louisiana waters ..... 1, 343; ii, 1312  
   Removal of, from Texas waters ..... 1, 343  
 Water-level observations:  
   Columbia River, Oreg. and Wash ..... 1, 619; iii, 2321  
   Michigan Lake, variations in surface level on east shore ..... 1, 498  
   Mississippi River and principal tributaries ..... 1, 405; ii, 1549; S., 7, 8, 62, 97  
   Northern and Northwestern Lakes, including report on outflow, rainfall, and evaporation ..... 1, 665; iv, 2678, 2855  
 Waters, navigable. *See Bridges, Rivers and harbors, and Wrecks.*  
 Water supply, Washington, D. C. *See Washington, D. C.*  
 Waterways (*see also Canals*):  
   Beaufort, N. C., to Newbern ..... 1, 235; ii, 1101  
   Beaufort, N. C., to New River ..... 1, 236; ii, 1103  
   Charleston to Beaufort, S. C., improvement of ..... 1, 255; ii, 1138  
   Charleston to Beaufort, S. C., sunken logs ..... 1, 257; ii, 1140  
   Charleston to McClellanville, S. C., with estimates of cost ..... 1, 252; ii, 1132  
   Chincoteague Bay, Va., to Delaware Bay, Del. .... 1, 180, 1002  
   Galveston to Houston, Tex. .... 1, 351; ii, 1334  
   Keweenaw Bay to Lake Superior, Mich., improvement and care ..... 1, 471, 472; ii, 1815  
   Keweenaw Bay to Lake Superior, Mich., wreck ..... 1, 475; ii, 1827  
   Lockport, Ill., to St. Louis, Mo., via Illinois, Des Plaines, and Mississippi rivers ..... 1, 494, 639; iii, 1904; S., 7, 68, 167  
   Norfolk, Va., to Albemarle Sound, N. C., via Currituck Sound ..... 1, 226; ii, 1084  
   Norfolk, Va., to sounds of North Carolina, via Pasquotank River. . 1, 225; ii, 1083  
   Portage Lake and Lake Superior canals, improvement and care ..... 1, 471, 472; ii, 1815  
   Portage Lake and Lake Superior canals, wreck ..... 1, 475; ii, 1827  
   Puget Sound to Lake Washington, bridge at Seattle, Wash. .... 1, 645  
   Puget Sound to Lake Washington, improvement and reexamination of ..... 1, 629; iii, 2332, 2340  
   Savannah, Ga., to Beaufort, S. C. (*see Savannah Harbor*) ..... 1, 257; ii, 1141  
   Savannah, Ga., to Ferdinandina, Fla. .... 1, 269; ii, 1166  
   Shreveport, La., to Jefferson, Tex. (*see Cypress Bayou*) ..... 1, 365; ii, 1372  
   Superior Lake to Lake Huron, final report on survey ..... 1, 542  
 Waukegan Harbor, Ill., improvement of ..... 1, 488; ii, 1864  
 Western Branch, Elizabeth River, Va., improvement of ..... 1, 220; ii, 1076  
 Western Bridge Company, bridge of ..... 1, 644  
 Western Maryland Tidewater Railroad Company, bridge of ..... 1, 649

- Western Pennsylvania Railroad Company, bridges of ..... i, 649  
 West Galveston Bay, Tex., improvement of ..... i, 354, 356; ii, 1339  
 West Neebish channel, St. Marys River, Mich., improvement of ..... i, 537; iii, 2027  
 Westport Harbor, Conn., improvement of ..... i, 118, 849  
 West River, Conn., bridge between New Haven and Orange, at Kimberly  
     avenue ..... i, 651  
 Wetipquin (Tyaskin) Creek, Md., improvement of ..... i, 190, 1018  
 Weymouth River, Mass., improvement of ..... i, 81, 771  
 Whatcom Creek and Harbor, Wash.:  
     Bridge across I and J streets waterway ..... i, 645, 646  
     Bridge across Whatcom Creek waterway ..... i, 647  
     Improvement of ..... i, 634; iii, 2337  
 White Cliffs, Ark., bridge across Little River ..... i, 646  
 Whitehall, N. Y.:  
     Improvement of Narrows of Lake Champlain ..... i, 72, 752  
     Removal of wrecks in Lake Champlain near ..... i, 73, 753  
 Whitehouse, Ky., bridge across Levisa Fork, Big Sandy River ..... i, 647  
 White House, Washington, D. C. .... i, 658; iv, 2517  
 White Lake Harbor, Mich., improvement of ..... i, 512; iii, 1962  
 White River, Ark.:  
     Bridge between Arkansas and Desha counties ..... i, 643  
     Bridge between Baxter and Marion counties ..... i, 644  
     Bridge at Newport ..... i, 642  
     Gauging (*see* Mississippi River Commission) ..... i, 639; S., 7, 8, 62, 97  
     Improvement by open-channel work ..... i, 379; ii, 1418  
     Improvement of Buffalo Fork ..... i, 382  
     Improvement of upper river by locks and dams ..... i, 381; ii, 1420  
 White River, Ind., improvement of ..... i, 460; ii, 1775  
 White River Railway Company, bridge of ..... i, 644  
 Wicomico River, Md., improvement of ..... i, 189, 1017  
 Willamette River, Oreg.:  
     Improvement above Portland ..... i, 609; iii, 2257  
     Improvement below Portland ..... i, 612; iii, 2263  
 Willapa River and Harbor, Wash., improvement of ..... i, 620; iii, 2323  
 Willels Point, N. Y., building for School of Submarine Defense at Fort Totten ..... i, 13, 16  
 Williams, O. C. (steamer), removal of wreck of ..... i, 281; ii, 1187  
 Williamsport (steamer), removal of wreck of ..... i, 103, 819  
 Willow River, Minn. (*see* Mississippi River reservoirs) ..... i, 398; ii, 1531  
 Wilmington, Cal.:  
     Construction of deep-water harbor in San Pedro Bay ..... i, 576; iii, 2173  
     Improvement of inner harbor ..... i, 577; iii, 2175  
 Wilmington, Del.:  
     Bridge across Brandywine Creek ..... i, 649, 650  
     Improvement of harbor ..... i, 174, 992  
 Wilmington, N. C.:  
     Defenses of Cape Fear River, including report on damp-proofing and on  
         use of paint made of coal tar and kerosene oil ..... i, 9; iv, 2408  
     Improvement of Cape Fear River at and below ..... i, 240; ii, 1109  
     Improvement of Cape Fear River above ..... i, 239; ii, 1105  
 Wilson Harbor, N. Y., improvement of ..... i, 564; iii, 2147  
 Wilson, Pa., harbor lines in Monongahela River ..... i, 640; ii, 1698  
 Wilson, Point, Cal. (*see* San Pablo Bay) ..... i, 583; iii, 2189  
 Wilson, Thomas (steamer), removal of wreck of ..... ii, 1828  
 Wind Point, Lake Michigan, Wis., reef off ..... i, 665; iv, 2883  
 Winnebago Lake, Wis. (*see* Fox River) ..... i, 489; ii, 1866  
 Winnibigoshish Lake, Minn.:  
     Construction of reservoir dam ..... i, 398; ii, 1528  
     Operating and care of reservoir dam ..... i, 399; ii, 1538  
 Winslow, Richard (barge), removal of wreck of, in Straits of Mack-  
     inac ..... i, 542; iii, 2046  
 Winthrop Cove, New London, Conn. (*see* New London) ..... i, 105, 833  
 Winyah Bay, S. C., improvement of ..... i, 246; ii, 1122  
 Wisconsin Central Railway Company:  
     Bridge of, across Fox River ..... i, 645  
     Bridge of, across Mississippi River ..... i, 650  
 Wisconsin Entrance, Duluth Harbor, Minn., improvement of ..... i, 466; ii, 1794

Wisconsin River, Wis.:	
Bridge at Prairie du Chien	i, 648
Improvement of ( <i>see</i> Fox River)	i, 489; ii, 1866
Withlacoochee River, Fla., improvement of	i, 288; ii, 1202
Wolf River, Memphis, Tenn. ( <i>see</i> Mississippi River Commission)	i, 639; S., 3, 40
Wolf (Ahnapee) River, Wis. ( <i>see</i> Ahnapee Harbor)	i, 480; ii, 1847
Wolf River (tributary of the Fox), Wis. ( <i>see</i> Fox River)	i, 489; ii, 1866
Woodbridge Creek, N. J., improvement of	i, 149, 935
Woods Hole channel, Mass., improvement of	i, 91, 793
Wrecks, etc., removal of	i, 35
Albany, N. Y.	i, 139, 888
Albemarle Sound, N. C.	i, 228; ii, 1088
Apalachicola, Fla., opposite	i, 306; ii, 1236
Arthur Kill, N. Y. and N. J.	i, 158, 159, 955, 956
Ashley River, S. C.	i, 257; ii, 1140
Bass Rip, Mass.	i, 104, 820
Bayonne, N. J.	i, 159, 955
Beaufort-Charleston, S. C., waterway, sunken logs	i, 257; ii, 1140
Bergen Point, N. J., opposite	i, 158, 954
Bergen Point reef, N. J., on	i, 158, 954
Black Warrior River, Ala.	i, 324; ii, 1272
Boothbay Harbor, Me.	i, 53, 727
Boston Harbor, Mass.	i, 88, 785
Braddock Point light station, Lake Ontario, N. Y.	i, 575; iii, 2169
Bronx River, N. Y.	i, 138, 139, 887
Brooklyn, N. Y., East River	i, 139, 887
Buffalo Bayou, Tex.	i, 360, 361; ii, 1347
Buttermilk channel, New York Harbor, N. Y.	i, 145, 925
Camden, N. J., Cooper Creek	i, 194, 1024
Cape Poge light-house, Mass.	i, 103, 819
Carters Creek, Va.	i, 218; ii, 1071
Champlain Lake, N. Y. and Vt.	i, 73, 753
Charleston-Beaufort, S. C., waterway, sunken logs	i, 257; ii, 1140
Chatham, Mass., off Hardings Beach light	i, 103, 820
Chincoteague light-house, Va.	i, 194, 1024
Cleveland Harbor, Ohio	i, 556; iii, 2105
Coeymans (North), N. Y.	i, 139, 888
Cohansey Creek, N. J.	i, 194, 1024
Cooper Creek, N. J.	i, 194, 1024
Cross Ledge light-house, Delaware Bay	i, 165, 971
Cumberland River, Dover Island Chute	i, 417; ii, 1589
Cumberland Sound, Ga. and Fla.	i, 271; ii, 1171
Deal Island Harbor, Md.	i, 194; 1024
Delaware Bay and River	i, 165, 971, 972
Dover Island Chute, Cumberland River	i, 417; ii, 1589
Duluth, Minn., Lake Superior near	i, 1828
East River, N. Y.	i, 139, 887
Elizabethport, N. J.	i, 158, 159, 955
Elizabeth River, N. J.	i, 159, 955
Erie Lake	i, 556; iii, 2103
Fairport Harbor, Ohio	i, 556; iii, 2106
False Egg Island Point, Delaware Bay	i, 165, 971
Fenwicks Island shoal, Md.	i, 194, 1024
Galveston Bay, Tex.	i, 360, 361; ii, 1347
Gowanus Creek, N. Y.	i, 145, 924
Green Run Inlet life-saving station, Md.	i, 194, 1023
Hampton Roads, Va.	i, 228; ii, 1088
Handkerchief shoal, Mass.	i, 103, 820
Hardings Beach light, Mass.	i, 103, 820
Hen and Chickens light-ship, Mass.	i, 104, 820
Hoboken, N. J.	i, 139, 887
Hoffman Island, New York Harbor, N. Y.	i, 145, 925
Hudson River, N. Y. and N. J.	i, 139, 887, 888
Hyannis Harbor, Mass.	i, 103, 819
Keweenaw Bay-Lake Superior waterway	i, 475; ii, 1827
Key West Harbor, Fla.	i, 281; ii, 1187
Lambs, S. C.	i, 257; ii, 1140

## Wrecks, etc., removal of—Continued.

Larabee Landing, Lake Champlain, Vt.	i, 73, 753
Leipsic River, Del.	i, 194, 1025
Little Creek, Del.	i, 194, 1023
Little Duck Creek (Leipsic River), Del.	i, 194, 1025
Lorain Harbor, Ohio.	i, 556; iii, 2104
Mackinac Straits, Mich.	i, 542; iii, 2046
Main Ship channel, New York Harbor, N. Y.	i, 145, 924, 925
Marine City, Mich.	iii, 2047
Maumee Bay, Ohio.	i, 557; iii, 2106
Metuchen, N. J.	i, 159, 955
Middle Island light-house, Lake Erie.	i, 556; iii, 2103
Mississippi River, above Missouri River.	i, 393; ii, 1463
Mississippi River, below Missouri River.	i, 389; ii, 1441
Mobile Harbor and River, Ala.	i, 324; ii, 1272
Monomoy Point, Mass.	i, 103, 819, 820
Nantucket Sound, Mass.	i, 103, 819, 820
Nauset Harbor, Mass.	i, 88, 785
Newark, N. J.	i, 159, 955
Newark Bay, N. J.	i, 158, 159, 954, 955
Newport News Point, Hampton Roads, Va.	i, 228; ii, 1088
New York Harbor, Arthur Kill, N. Y.	i, 158, 159, 955, 956
New York Harbor, Bronx River, N. Y.	i, 138, 139, 887
New York Harbor, Buttermilk channel, N. Y.	i, 145, 925
New York Harbor, East River, N. Y.	i, 139, 887
New York Harbor, Gowanus Creek, N. Y.	i, 145, 924
New York Harbor, Hoffman Island, N. Y.	i, 145, 925
New York Harbor, Hudson River near Hoboken, N. J.	i, 139, 887
New York Harbor, Main Ship channel, N. Y.	i, 145, 924, 925
New York Harbor, Southwest Spit, N. Y.	i, 145, 925
New York Harbor, off Tompkinsville, N. Y.	i, 145, 924
North Coeymans, N. Y.	i, 139, 888
North (Hudson) River, N. Y.	i, 139, 887
North River, N. C.	i, 228; ii, 1088
Ontario Lake.	i, 575; iii, 2169
Pasquotank River, N. C.	i, 228; ii, 1088
Passaic, N. J., in Passaic River.	i, 158, 954
Passaic Bridge, in Passaic River.	i, 158, 954
Passaic light-house, Newark Bay, N. J.	i, 159, 955
Passaic River, N. J.	i, 158, 159, 954, 955
Philadelphia, Pa., Delaware River.	i, 165, 971
Philadelphia, Pa., Schuylkill River.	i, 194, 1024
Poge, Cape, light-house, Mass.	i, 103, 819
Pollock Rip light-ship, Mass.	i, 103, 819
Popes Island, Va.	i, 194, 1024
Portage Lake canals, Mich.	i, 475; ii, 1827
Port Huron, Mich., near.	iii, 2047
Port Reading, N. J.	i, 159, 956
Potomac River, Md.	i, 218; ii, 1071
Ram Island light-house, Boothbay Harbor, Me.	i, 63, 727
Rancocas River, N. J.	i, 194, 1023
Raritan River, N. J.	i, 159, 955
River View, Potomac River, Md.	i, 218; ii, 1071
St. Clair River, Mich.	i, 542; iii, 2046, 2047
Sankaty Head, Nantucket Island, Mass.	i, 104, 820
Savannah Harbor, Ga.	i, 271; ii, 1171
Schuylkill River, Pa.	i, 194, 1024
Ship John light-house, Delaware Bay.	i, 165, 971, 972
Shipyards Landing, Pasquotank River, N. C.	i, 228; ii, 1088
Shovelful shoal, off Monomoy Point, Mass.	i, 103, 819, 820
Southwest Spit, New York Harbor, N. Y.	i, 145, 925
Starve Island reef, Lake Erie.	i, 556; iii, 2105
Staten Island Sound (Arthur Kill), N. Y. and N. J.	i, 158, 159, 955, 956
Superior Harbor, Wis., Lake Superior, near.	ii, 1828
Superior Lake, near Duluth, Minn.	ii, 1828
Superior Lake-Keweenaw Bay waterway.	i, 475; ii, 1827
Tangier Sound, Md., Deal Island Harbor.	i, 194, 1024

## Wrecks, etc., removal of—Continued.

Toledo Harbor, Ohio, Maumee Bay.....	i, 557; iii, 2106
Tompkinsville, N. Y.....	i, 145, 924
Tucker Beach light-house, N. J.....	i, 194, 1026
Vineyard Sound light-ship, Mass.....	i, 104, 820
Wachapreague Inlet life-saving station, Va.....	i, 194, 1024
Wade Point light, Albemarle Sound, N. C.....	i, 228; ii, 1088
Warrior River, Ala.....	i, 324; ii, 1272
Whitehall, N. Y.....	i, 73, 753
York River, Va.....	i, 218; ii, 1071
Wyandotte, Mich. ( <i>see</i> Detroit River).....	i, 540; iii, 2036

## Y.

## Yamhill River, Oreg.:

Improvement of.....	i, 609; iii, 2257
Operating and care of lock and dam.....	i, 612; iii, 2261
Yankton, S. Dak. ( <i>see</i> Missouri River).....	i, 405; ii, 1551
Yaquina Bay, Oreg., improvement of.....	i, 600; iii, 2215

## Yazoo River, Miss.:

Improvement above mouth.....	i, 373; ii, 1396
Improvement of mouth, including Vicksburg Harbor.....	i, 370; ii, 1385
Yellow Mill Pond, Bridgeport, Conn. ( <i>see</i> Bridgeport).....	i, 115, 846
Yellowstone National Park, improvement of, with report giving technical details.....	i, 666; iv, 2444, 2885

## York River, Va.:

Improvement of.....	i, 204; ii, 1050
Removal of wreck.....	i, 218; ii, 1071
Yuba River, Cal. ( <i>see</i> Sacramento River and California Débris Commission).....	i, 587, 638; iii, 2194, 2368

## O











